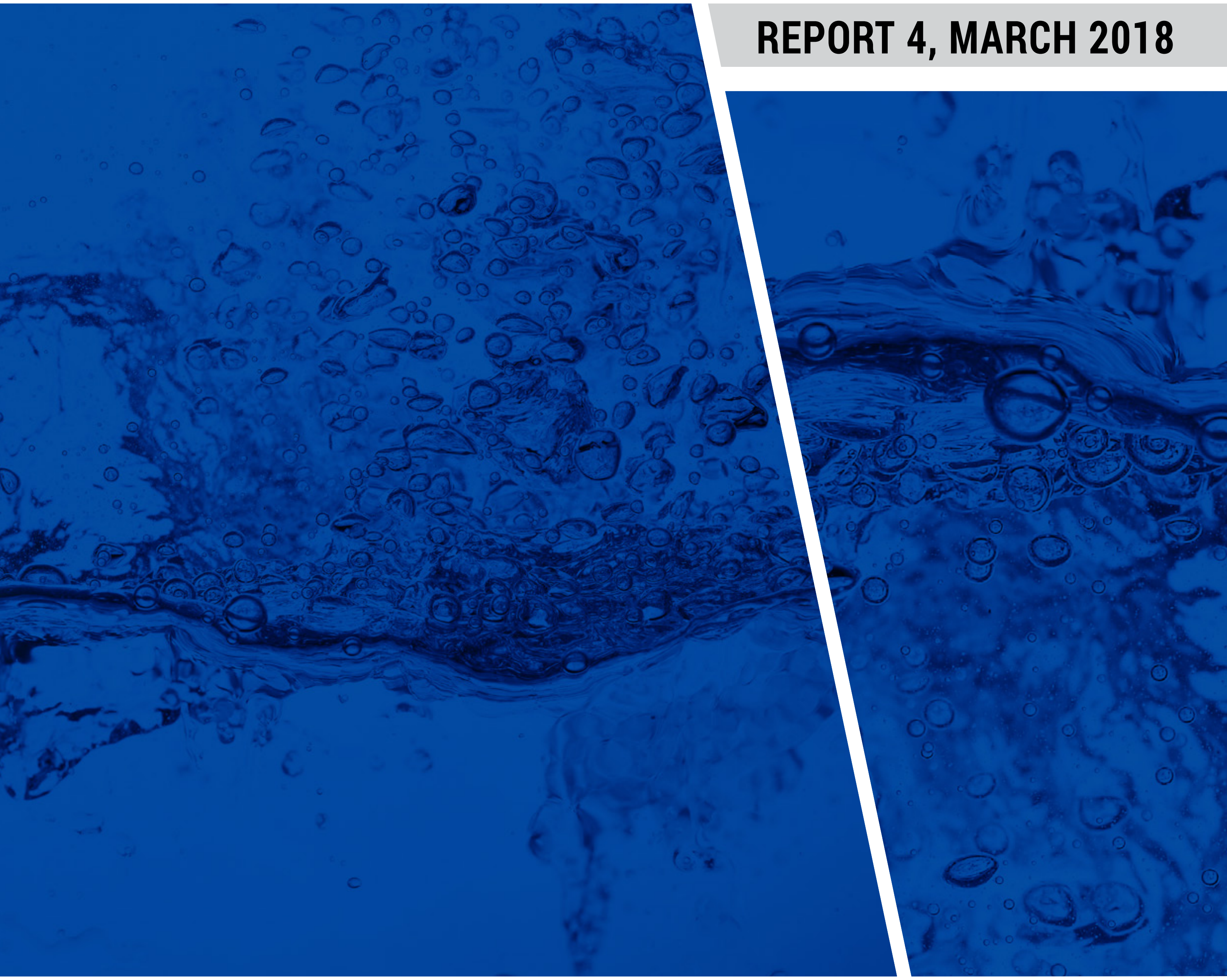
NATIONAL WASTEWATER DRUG MONITORING PROGRAM

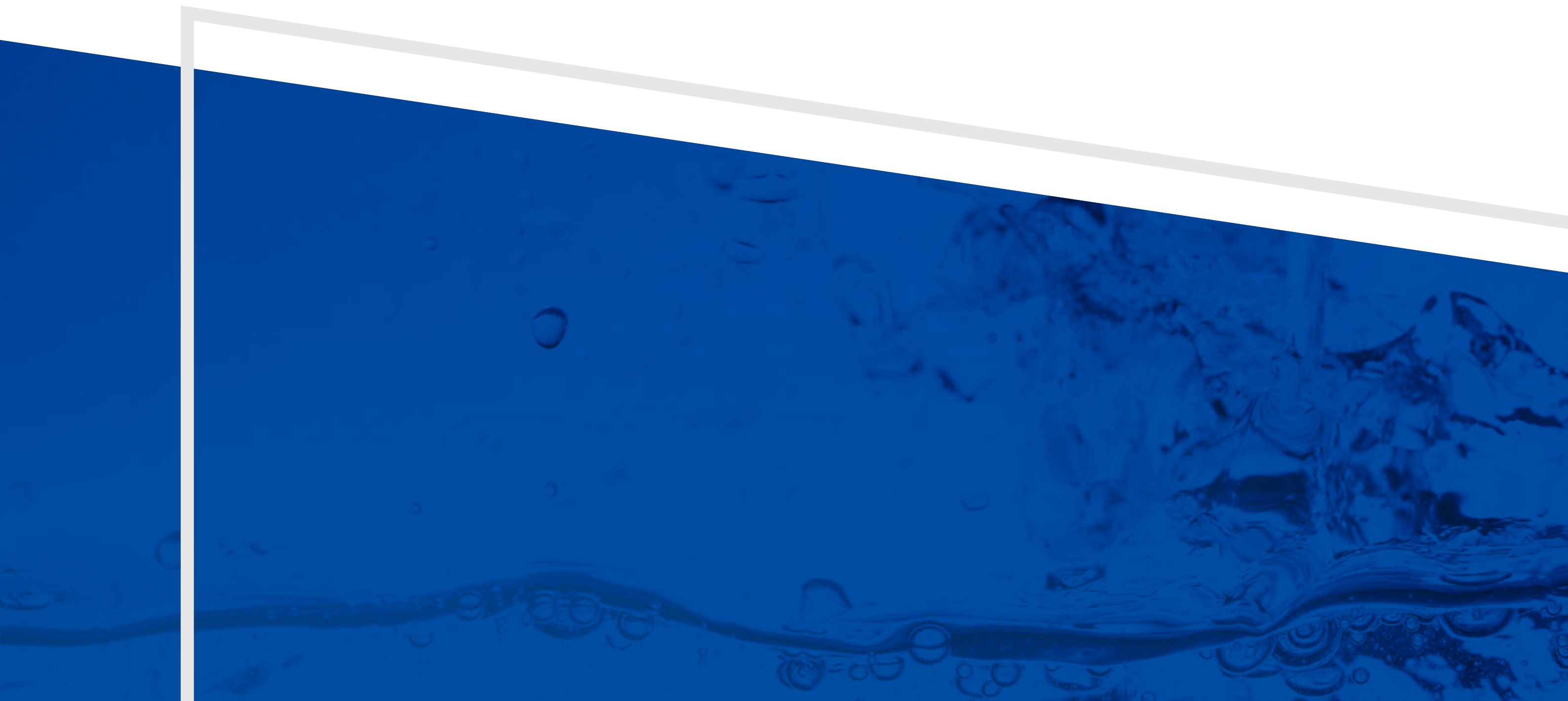
REPORT 4, MARCH 2018



AUSTRALIAN CRIMINAL INTELLIGENCE COMMISSION

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

University of South Australia



CONTENTS

CEO FOREWORD

The Australian Criminal Intelligence Commission has a national responsibility to provide information and intelligence on criminal activity. Much of the harm that Australians suffer at the hands of organised crime is due to the trade in illicit substances and abuse of licit substances at the instigation of serious and organised crime groups who profit from importing, trafficking, manufacturing and selling drugs.

This National Wastewater Drug Monitoring Program report is the fourth in a series of nine public reports which will detail the findings of the national wastewater program until the end of 2019. This report provides statistically valid datasets of drug use and distribution patterns across a large number of sites in capital cities and regional areas.

Wastewater analysis is widely applied internationally as a tool to measure and interpret drug use within national populations, with the current national program in Australia representing world best practice. Wastewater analysis provides a measure of one important aspect of national health—the demand for a range of licit and illicit drugs. An understanding of this behaviour allows governments to effectively direct resources to priority areas, and also to monitor the progress of demand and supply reduction strategies.

EVOLUTION OF THE PROGRAM

This report includes wastewater data from all states and territories, enabling the National Wastewater Drug Monitoring Program to provide a national picture of drug use. In December 2017, 45 wastewater sites were monitored nationally. Based on 2016 Census data, these sites cover approximately 54 per cent of the Australian population—around 12.7 million people. This report contributes further data to permit the identification of changes in usage patterns over the 17-month period from August 2016 to December 2017 and to build a comprehensive and increasingly detailed picture of national drug consumption.

The content of this report involves a natural evolution of the existing National Wastewater Drug Monitoring Program. Changes of note in this report include the adoption of more sophisticated population estimates of wastewater treatment catchments, derived using the latest Census data from the Australian Bureau of Statistics and geographical information system analysis of populations reported within wastewater treatment catchments. These refinements increase both the precision and accuracy of consumption estimates and have been applied to all data presented in this report. We are grateful to our partners at the University of Queensland and University of South Australia for their ongoing efforts to enhance and deliver a leading edge program.

TRENDS IDENTIFIED DURING THIS REPORTING PERIOD

Of the drugs measured, consistent with previous reports, alcohol and nicotine continue to be the most consumed drugs in Australia. Methylamphetamine remains the most consumed illicit drug, with average consumption increasing since August 2017.

Consumption of other drugs measured by the program remains considerably lower. Although the previous report indicated a decrease in average cocaine consumption between April and August 2017, recent data indicate a noticeable increase in consumption. The consumption of MDA and MDMA remains low and variable across sites. In general, heroin consumption was lower than fentanyl and oxycodone consumption in most states and territories, with average regional consumption of fentanyl and oxycodone exceeding that in capital city sites. Mephedrone and methylone consumption remain low, at or below detection levels.

ADDITIONAL INSIGHTS GAINED FROM WASTEWATER ANALYSIS

Wastewater analysis provides a measure of the demand for a range of licit and illicit drugs. Analysis of wastewater data offers opportunities to address emerging problems, identify previously unknown drug threats and consumption patterns, and assists to measure the effectiveness of harm reduction initiatives and supply disruption strategies.

On comparing drug seizure data published in the *Australian Federal Police Annual Report 2016–17* and annual national drug consumption estimates derived from wastewater analysis for methylamphetamine, MDMA, cocaine and heroin, it is evident demand for harmful drugs remains robust. Based on the reported weights seized by the Australian Federal Police in 2016–17 and consumption estimates from the National Wastewater Drug Monitoring Program:

- the weight of heroin seized equated to around a quarter of the total estimated weight of heroin required to meet national demand
- the weight of methylamphetamine seized equated to over 40 per cent of the total estimated weight of methylamphetamine needed to meet national demand
- the weight of MDMA seized equalled the total estimated weight of MDMA needed to meet national demand
- the weight of cocaine seized exceeded the total estimated weight of cocaine needed to meet national demand.

The above examples highlight the resilience of drug markets and the enduring demand for drugs in Australia. They again reinforce that no single strategy in isolation can achieve sustained impacts and the ongoing necessity to employ a shared approach that targets supply, demand and harm reduction.

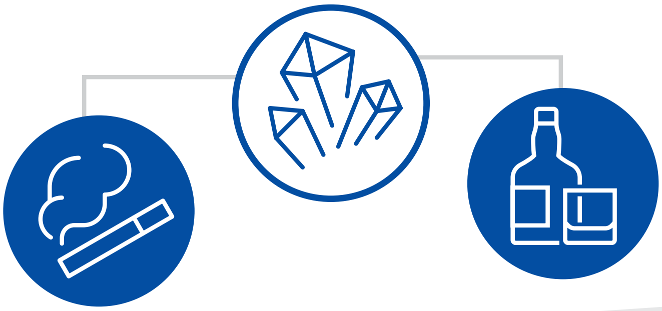
I would like to thank the Australian Government for contributing the funding which made this initiative possible, and to acknowledge the Australian Criminal Intelligence Commission officers who contributed to the project. I am grateful for the valuable support and specialist expertise of the University of Queensland and the University of South Australia, who undertook the data collection and analysis which underpins this report.

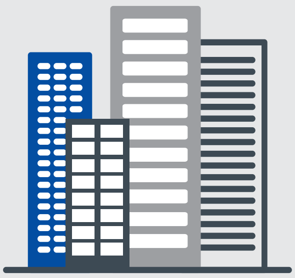
Michael Phelan APM
Chief Executive Officer
Australian Criminal Intelligence Commission

SNAPSHOT

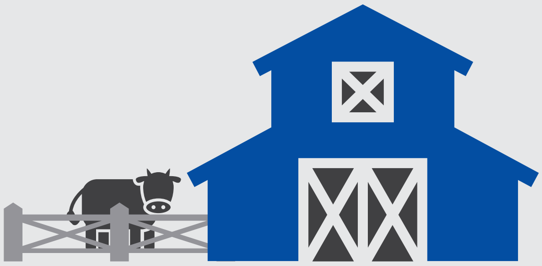
The December 2017 collection covers **54.3 per cent** of Australia's population—about **12.7 million Australians.**

Alcohol and **nicotine** remain the **highest consumed substances** and **methylamphetamine** continues to be the **most consumed illicit drug** tested.





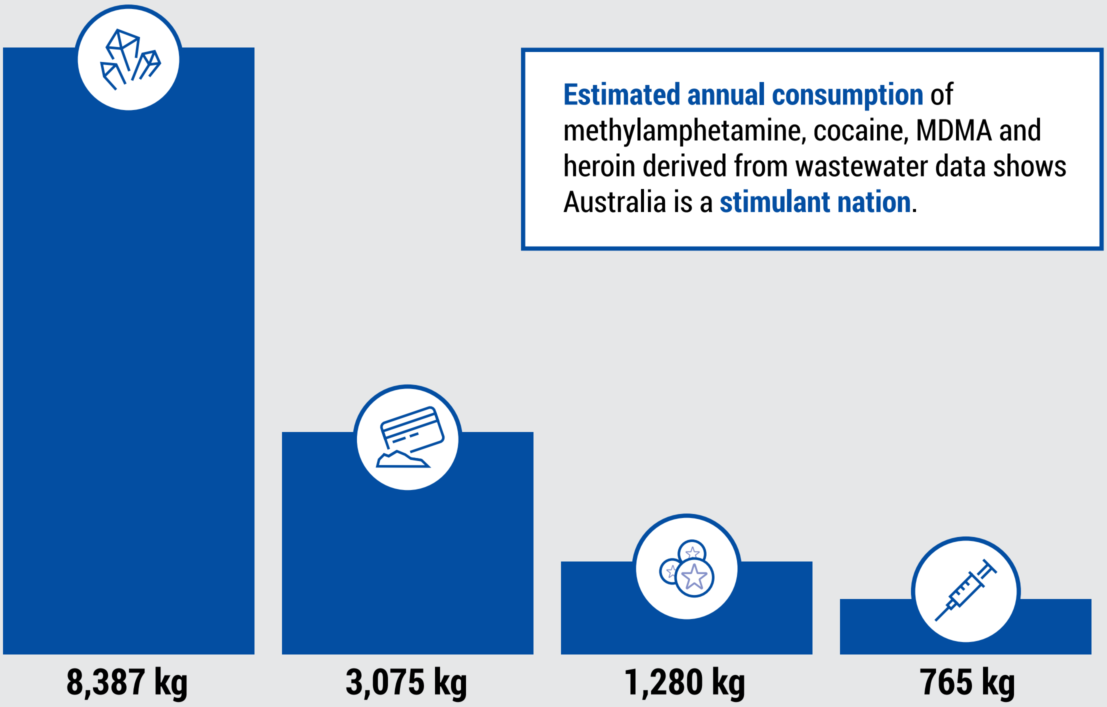
Capital city **cocaine** and **heroin** average consumption exceeded regional consumption.



Regional **nicotine, methylamphetamine, MDA, oxycodone** and **fentanyl** average consumption exceeded capital city consumption.

Use of new, sophisticated **geospatial analysis methods** incorporating water treatment catchment maps and **2016 Australian Census** mesh blocks gives more **accurate** and **precise consumption estimates**.

Estimated annual consumption of methylamphetamine, cocaine, MDMA and heroin derived from wastewater data shows Australia is a **stimulant nation**.



Based on wastewater consumption estimates, in 2016–17 Australian Federal Police seized:

Around a **quarter** of the **heroin** needed to meet national demand

Over 40 per cent of the **methylamphetamine** needed to meet national demand

The **total weight** of **MDMA** needed to meet national demand

In excess of the total weight needed to meet national demand for **cocaine**

INTRODUCTION

This is the fourth in a series of nine National Wastewater Drug Monitoring Program reports to be publicly released by the Australian Criminal Intelligence Commission. The program aims to deliver on the recommendations of the *Final Report of the National Ice Taskforce*. It is the first program to provide leading-edge, coordinated national research and intelligence on illicit and licit drugs, with a specific focus on methylamphetamine and 11 other substances.

In 2016, the Australian Criminal Intelligence Commission received $3.6 million in funding under the *Commonwealth Proceeds of Crime Act 2002* to deliver the National Wastewater Drug Monitoring Program over three years. The program provides a measure, rather than an estimate, of the use of a number of illicit drugs, as well as licit drugs including nicotine, alcohol and some pharmaceuticals. It gives us valuable insight into the trends and emerging issues of drug consumption across Australia and can identify new sources of threat.

The findings presented in the nine reports will give law enforcement, policy, regulatory and health agencies additional and more objective data on the use of methylamphetamine and other drugs. This data creates opportunities to shape the response to both the demand and the supply side of the illicit drug market, particularly in high-use areas.

IMPLEMENTATION

The Australian Criminal Intelligence Commission has contracted the University of Queensland, and through it the University of South Australia, to deliver the program. Relationships have been built between the universities and the operators of wastewater facilities across Australia to permit the collection and analysis of samples.

In this report, wastewater analysis from the National Wastewater Drug Monitoring Program measured the presence[1] of the following substances:

- methylamphetamine
- amphetamine
- cocaine
- 3,4-methylenedioxymethylamphetamine (MDMA)
- 3,4-methylenedioxyamphetamine (MDA)
- heroin
- mephedrone
- methylone
- oxycodone
- fentanyl
- nicotine
- alcohol.

1 The contract recognises that threshold levels are substance dependent and will vary accordingly. Refer to the research findings for further information on detection levels, and whether it was possible to measure all substances.

The first five substances are widely recognised illicit stimulants. Heroin is an illicit depressant. The next two substances, mephedrone and methylone, are illicit synthetic stimulants and are described as new psychoactive substances (NPS).[2] Oxycodone and fentanyl are opioid pharmaceuticals with therapeutic application, but are also diverted to the illicit market. Nicotine and alcohol are licit drugs. The Australian Criminal Intelligence Commission will continue to review the appropriateness of the monitored substances with its partners, stakeholders and the universities.

Both contracted universities will monitor wastewater at approximately 50 sites across Australia until the end of 2019. It is the intention of the program that capital city sites cover all state and territory capital cities, with the remaining sites covering regional cities and towns. Capital city sites will be monitored for the duration of the program, while the remaining sites will be reassessed periodically. Sites were selected to permit the Australian Criminal Intelligence Commission to provide data on major population areas, sites of actual or potential concern from a drug use perspective, and sites where the local authorities have established relationships with the two universities. In December 2017, 45 wastewater treatment plants participated nationally.

The breakdown of sites by jurisdiction for December 2017 is as follows:

2 Two other NPS, JWH-018 and JWH-073, which are synthetic cannabinoids are no longer monitored by the National Wastewater Drug Monitoring Program as they have not been detected in sites across Australia since monitoring commenced in August 2016.

The Australian Criminal Intelligence Commission will continue engaging with all states and territories in an attempt to secure their ongoing participation in sampling for future reports. Participation from all states and territories is vital to informing our understanding of the national picture of drug use and demand. In the event that one or more states and territories decide not to participate in the national program in the future, the Australian Criminal Intelligence Commission will identify replacement sites from participating states and territories to ensure that the largest possible segment of the national population is sampled. Accordingly, the location of sites within and between states and territories may change over the three years of the contract.

REPORTING

National Wastewater Drug Monitoring Program reports will be published as comprehensive public reports three times a year, in line with the program contract. In accordance with current wastewater analysis conventions, the terms of the contract, and to protect the integrity of the program, the exact locations of wastewater treatment plants will not be publicly released by the Australian Criminal Intelligence Commission.

To maintain the confidentiality of the participating sites, each site was allocated a unique code so that results could be de-identified. However, trends in particular states and territories are still able to be identified. The public reports will incorporate a discussion of trends in drug use where distinct trends are seen—for example, between regional areas and capital cities, or between states and territories and nationally—and will include comparisons with testing from previous years where that data is available.

In order to inform appropriate responses, stakeholders in law enforcement, health and other relevant policy agencies may be provided with classified information identifying actual sampling locations.

EXPLOITATION OF THE NATIONAL WASTEWATER DRUG MONITORING PROGRAM DATA

The Australian Criminal Intelligence Commission intends that the findings of the National Wastewater Drug Monitoring Program analysis will be fundamental to the development of government policy and decision making, as the reports will provide a regular, timely, unambiguous and detailed measure of the level of demand for the listed commodities in the Australian population, complementing other drug datasets published in Australia. The fourth National Wastewater Drug Monitoring Program report measures drug use by approximately 54 per cent of the Australian population.[3] It is hoped that wastewater data will be used with other available data sources to obtain a more comprehensive and accurate understanding of drug markets nationally and in the respective states and territories.

3 The December 2017 population estimate is based on the Australian Bureau of Statistics 2016 Census data and catchment data supplied by the operators of the wastewater facilities and service providers.

The Australian Criminal Intelligence Commission continues to engage with academic institutions, industry and public sector agencies concerning potential uses for data generated by the National Wastewater Drug Monitoring Program. Discussions have centred upon focusing responses in particular high-risk areas, measuring drug use in particular local areas, estimating the size of specific illicit markets, comparing wastewater data with other drug-related data and exploring options for monitoring the effectiveness of existing demand, supply and harm reduction initiatives. The advantage the National Wastewater Drug Monitoring Program offers in all these contexts is that the data is collected on an ongoing basis, is reported regularly and can be shaped to accommodate changing circumstances.

Making the National Wastewater Drug Monitoring Program data available to the public and to public agencies enriches understanding and informs the national conversation on drug trends and related demand. Because the collection and analysis protocols are similar, it is also possible to compare domestic drug consumption with international drug consumption,[4] which may stimulate further discussions on alternative responses to the threat posed by drug use.

Wastewater has been identified as offering an important, unified and consistent guiding tool in developing holistic drug responses. The National Wastewater Drug Monitoring Program is based on a well-established and internationally recognised methodology which has been applied to varying extents by many other nations. Australia is one of the few countries in the world where the program is funded by a national government, with the scope of sampling in Australia generating data which will help governments at both a state and national level to formulate appropriate responses.

ESTIMATED NATIONAL CONSUMPTION

The Australian Criminal Intelligence Commission used wastewater data collected between August 2016 and August 2017 to estimate the annual weight of methylamphetamine, MDMA, cocaine and heroin consumed nationally (see Table 1). While the estimates are conservative, they provide valuable insight into Australia's demand for illicit drugs that could not have been gained without the program.

Table 1: Estimated annual national methylamphetamine, cocaine, MDMA and heroin consumption between August 2016 and August 2017.

Drug	Estimated consumption kilograms per year
Methylamphetamine	8,387
Cocaine	3,075
MDMA	1,280
Heroin	765

4 International data from the Sewage analysis CORe group Europe (SCORE) was not available in time for it to be incorporated into this report. This information will be included in the fifth report, to be released in the third quarter of 2018.

To put the size of the Australian methylamphetamine market into context, the total combined estimated weight of cocaine, MDMA and heroin consumed annually equates to around 60 per cent of the estimated weight of methylamphetamine consumed annually. This data also illustrates the variation in the size of these markets, with the estimated weight of methylamphetamine consumed annually being 6½ times that of MDMA and the estimated weight of cocaine consumed annually being four times that of heroin.

In addition to providing insight into how the different drugs in the program compare, these consumption estimates also enable comparisons with seizure data. On comparing the estimated weight of methylamphetamine, cocaine, MDMA and heroin consumed annually with the weight of related drug seizures reported in the *Australian Federal Police Annual Report 2016–17:*

- The weight of heroin seized equated to around a quarter of the total estimated weight of heroin required to meet national demand.
- The weight of methylamphetamine seized equated to over 40 per cent of the total estimated weight of methylamphetamine needed to meet national demand.
- The weight of MDMA seized equalled the total estimated weight of MDMA needed to meet national demand.
- The weight of cocaine seized exceeded the total estimated weight of cocaine needed to meet national demand.

From the above data it is evident that demand for these drugs remains robust and that a shared approach that targets supply, demand and harm reduction is critical to addressing drug use in Australia. Drug consumption estimates derived from wastewater data, when used in combination with other data such as seizure, arrest, price, purity and availability data, provide greater insight into the related markets and the potential impact of supply, demand and harm reduction strategies.

EVOLUTION OF THE PROGRAM

The Australian Criminal Intelligence Commission will continue to work with the participating universities to enhance the program. Since its launch, the program has explored and implemented various enhancements that contribute to the delivery of better data and a better and more granular understanding of drug consumption in Australia. These enhancements include the ability to compare Australia's drug consumption with measured consumption in different countries, and the inclusion of additional substances in the monitoring program as new methodologies are developed and endorsed by the scientific community. Discussions also include whether it may be possible to use alternative metabolites of some substances to more precisely measure their consumption in the community.

The fourth National Wastewater Drug Monitoring Program report reflects a further evolution of the program. For the first time the program implemented a new, more sophisticated methodology to estimate populations captured by wastewater treatment plant catchments, with the population estimate of usual residents within each catchment being refined using catchment maps provided by wastewater treatment authorities and 2016 Australian Census mesh blocks. This methodology incorporates the latest Australian Census data and will result in more precise and accurate population estimates for the areas covered by the program.

Wastewater data is an important part of the suite of datasets available to increase our understanding of drug consumption, demand and supply in Australia. Existing and future work incorporating wastewater data will include a comparison of consumption data with drug seizures in Australia. The Australian Criminal Intelligence Commission is working to ensure the broadest possible range of stakeholders are engaged throughout the life of the program, consulting with stakeholders through existing drug forums and direct discussions with agencies. This includes working with industry to increase our understanding of drug markets in Australia.

RESULTS FROM THE FOURTH REPORT

This fourth report of the National Wastewater Drug Monitoring Program builds on national drug consumption data contained in the preceding three public reports identifying drug use patterns across states, territories and the nation. It provides data on capital city and regional drug use and, where possible, comparisons with previous levels of use in sites across Australia. This and future reports will contribute further data to identify trends, changes in patterns of use and emerging issues, building a comprehensive and increasingly detailed picture of national drug consumption. Benefits of longitudinal wastewater data include the identification of emerging trends and patterns of use. This is illustrated through the cocaine data, where the population-weighted averages for cocaine consumption have doubled in capital city sites since August 2016, with almost a three fold increase observed in regional sites.

Reported results reflect per capita use in all locations and, with the exception of MDA, are expressed in terms of both the number of doses and the weight or volume per capita of the respective substances, to facilitate comparison between substances.

RESEARCH FINDINGS

Prepared by the University of Queensland (B Tscharke, R Mackie, J O'Brien, S Grant, J Mueller) and University of South Australia (M Ghetia, H Aghera, R Bade, C Gerber, J White).

LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACIC	Australian Criminal Intelligence Commission
ACT	Australian Capital Territory
GIS	Geographic information system
LC-MS/MS	Liquid chromatography tandem mass spectrometry
LOD	Limit of detection
LOR	Limit of reporting
MDA	3,4-methylenedioxyamphetamine
MDMA	3,4-methylenedioxymethylamphetamine
NPS	New psychoactive substances
NSW	New South Wales
NT	Northern Territory
NWDMP	National Wastewater Drug Monitoring Program
QLD	Queensland
SA	South Australia
SPE	Solid phase extraction
TAS	Tasmania
VIC	Victoria
WA	Western Australia
WWTP	Wastewater treatment plant

TERMINOLOGY

Methylamphetamine is also commonly known as methamphetamine. In this report, consistent with the preferences of the Australian Criminal Intelligence Commission, 'methylamphetamine' is used.

MDMA is commonly known as ecstasy.

Alcohol consumption in this report refers to ethanol consumption but the more general term 'alcohol' is used throughout.

Nicotine consumption has replaced tobacco consumption in this report as the target metabolites may also be derived from nicotine replacement products, such as gums and patches.

1: EXECUTIVE SUMMARY

Wastewater analysis is now a standard method for measuring population-scale use of a range of different chemical compounds. The underlying concepts involved in wastewater analysis were demonstrated in the first national Australian report released in March 2017. Estimates of drug usage in a population were back calculated from measured concentrations of drug metabolites (excreted into the sewer system after consumption) in wastewater samples. Spatial and temporal trends in drug use have now been included using this approach for several sites across Australia. The National Wastewater Drug Monitoring Program (NWDMP) of the Australian Criminal Intelligence Commission (ACIC) monitors selected substances of concern in most populated regions of Australia. The study now focuses on twelve licit and illicit drugs, including nicotine, alcohol, methylamphetamine, cocaine, MDMA (ecstasy) and heroin. Trends in estimated drug consumption will be established over the three-year project. Wastewater treatment plants (WWTPs) located across capital cities and regional Australia, covering all states and territories, have been invited to participate in this program. Previous reports used population estimates provided by the wastewater treatment authorities. For the first time the estimate of the usual residents within each catchment has been refined. Catchment maps provided by the wastewater treatment authorities were layered on the smallest available units of Census population counts (mesh blocks) in geographic information systems (GIS) software to yield the highest resolution population estimate available for the catchments based on Census data. The resulting overlapping usual resident population within each catchment was calculated and has been applied to all data presented in this report, which increases both the precision and accuracy of the consumption estimates.

For this fourth report, wastewater samples were collected during weeks of October and December 2017. A total of 20 WWTPs in capital cities and a further 25 regional sites participated in the project for the December 2017 period, covering a population of more than 12 million Australians. Data from this report equates to coverage of approximately 48 per cent and 54 per cent of Australia's population for October and December, respectively. A total of 1,839 individual daily samples have been assessed since the beginning of the program, with new results from 414 additional samples added in this report. The collected samples provide relatively comprehensive, Australia-wide baseline data against which subsequent data can continue to be compared to ascertain both spatial and temporal trends. Twenty-four-hour composite wastewater samples were collected using time-proportional or flow-proportional autosamplers at the influent of each WWTP by plant operators. Samples were collected for up to seven consecutive days. Concentrations of drug metabolites were determined in the wastewater using liquid chromatography-tandem mass spectrometry (LC-MS/MS) analytical methods. Drug consumption estimates for each catchment population were calculated from these measured concentrations using flow volumes and estimates of the catchment population size by Census data vs. catchment maps evaluation, together with excretion and dose data derived from the scientific literature.
To maintain treatment plant confidentiality, each site was allocated a unique code and site names are not included in this report.

The estimated drug usage across the 45 sites (December 2017) was consistent with previous reports. After normalising the amount of drug measured in wastewater for population size and average dose consumed, alcohol and nicotine were consistently the highest consumed drugs in all states and territories. Estimated consumption of nicotine was generally higher in regional areas compared to capital cities. In the case of alcohol, the difference was less pronounced. The Northern Territory had the highest consumption of nicotine and alcohol, but with only one participating site, the result may not be representative of the Territory as a whole. In other parts of Australia, alcohol consumption was similar for the most part, except for regional South Australia, where it was relatively low. This may be a consequence of samples being provided for weekdays only, when consumption is typically lower. Nicotine use across the nation was fairly consistent.

Methylamphetamine remains the highest of the illicit drugs included in the report, in both capital cities and regional sites, and shows no tendency to decline. The highest methylamphetamine levels were seen in South Australia (capital city) and Western Australia (regional).

Amphetamine is a metabolite of methylamphetamine and measured amphetamine concentrations across the sites were consistent, with the observed levels being primarily related to methylamphetamine metabolism rather than sourced from direct consumption.

Compared to methylamphetamine, estimated usage of other stimulants was generally much lower, although no consistent pattern (profile) of usage for these other drugs could be observed between states and territories. Cocaine consumption in Australia is mostly centred in New South Wales across several capital city and regional sites. Levels in Queensland and the Australian Capital Territory have both increased to become nearly second highest in the nation. In comparison, usage was low at sites elsewhere around the country. MDMA usage was similarly low across most sites with a few site-specific exceptions.

Oxycodone and fentanyl, which are both prescription pharmaceutical substances with abuse potential, had elevated consumption levels at several regional sites. Regional areas had average oxycodone use well above capital city sites in many states. Consumption of heroin varied widely, with minimal amounts detected in the Northern Territory and high levels recorded in sites in Victoria and the Australian Capital Territory, as well as a few individual sites in other states.

After removing the proportion of MDA attributable from MDMA metabolism, use of the drug appeared variable across the nation, with South Australia being the lowest. A feature was a site in regional Queensland where measured levels were extremely high. For the other drugs included in this study, methylone and mephedrone concentrations were generally at or below detection levels at all participating sites.

The collection of wastewater samples at regular intervals allowed for the temporal comparison of consumption data. While small overall changes were evident at both a site and a state or territory level, more data are required to draw longer term conclusions. The recent declines in methylamphetamine use in Queensland and Western Australia, and to a lesser extent South Australia, were clear reversals in longer term trends. A gradual reduction in pharmaceutical opioid use, particularly oxycodone, was also apparent.

2: INTRODUCTION

2.1. PREAMBLE

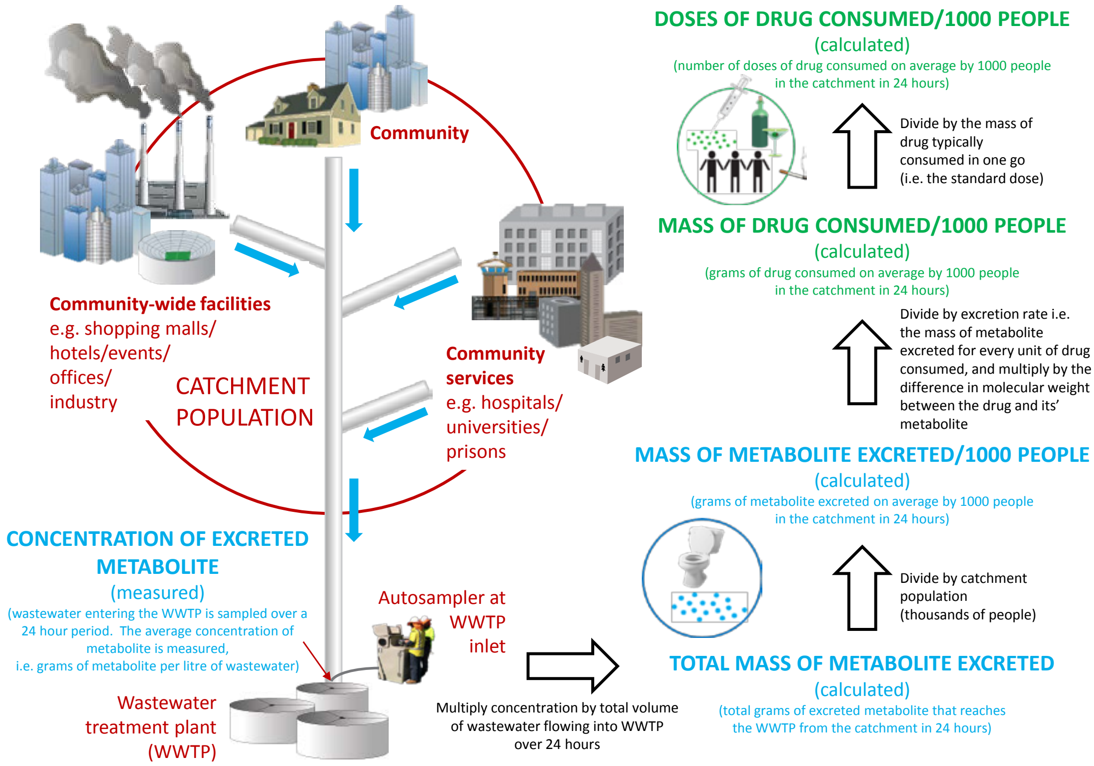
Wastewater analysis is a technique for delivering population-scale consumption of substances. The University of Queensland and University of South Australia have been commissioned to provide drug consumption data to the ACIC for a period of three years, beginning in August 2016. Wastewater treatment sites are assessed bimonthly in the case of capital city sites and every four months for regional sites. The aim is to acquire data on the population-scale use of substances that cause potential harm, either through addiction, health risks, or criminal and antisocial behaviour. The intention is to establish baseline data of substance use across Australia. This fourth National Wastewater Drug Monitoring Program report compares consumption data from the first three reports with results obtained subsequently from October and December 2017.

Compounds of concern include nicotine (cigarettes, gum, patches, e-cigarettes, etc), ethanol from alcohol intake, pharmaceutical opioids with abuse potential, illicit substances such as methylamphetamine, MDMA, cocaine and heroin, as well as a number of new psychoactive substances (NPS). The compounds amphetamine and MDA were measured but not included in the initial reports. Amphetamine is a by-product of methylamphetamine pyrolysis and also one of its metabolites and we found the levels to correspond fully to the excretion of methylamphetamine. MDA is a metabolite of MDMA, but since the proportion of MDA derived from MDMA is known, the difference between measured MDA and MDMA metabolite has now been included in the current report. The amount of MDA was calculated by subtracting 1.65 mg of MDA for every 100 mg of MDMA consumed (Pizarro et al. 2002; Khan & Nicell 2011). The report presents patterns of substance use across Australia, showing differences in levels between capital cities and regional centres, within states and territories, and nationally.

3: METHODS

The method underlying wastewater based monitoring of drug use in a given population is based on the principle that any given compound that is consumed (irrespective of whether it is swallowed, inhaled/smoked or injected) will subsequently be excreted (either in the chemical form it is consumed and/or in a chemically modified form that is referred to as a metabolite). The excreted compound or metabolite will eventually arrive in the sewer system. The drugs and their metabolites of interest in this study are given in the first National Wastewater Drug Monitoring Program report (available at www.acic.gov.au), as well as an in-depth description of the methodologies involved.[1] Collectively, waste products in the sewer system arrive at a WWTP where wastewater samples are collected over a defined sampling period. Measuring the amount of target compound in the wastewater stream allows for a back calculation factor to be applied to determine the amount of drug that was used over the collection period (Figure 1). The method is non-invasive and is done on a population-scale level, so individuals are not targeted and privacy is respected.

Figure 1: Schematic of the population catchment area and methodology employed to convert measured concentration of substances in wastewater to mass loads or doses consumed per day per normalised population.



To obtain an estimate of drug use, representative samples are collected over a given period (typically 24 hours) using autosamplers that collect time or flow proportional samples. Wastewater treatment plant operators provide assistance with collecting the samples from the influent autosampler (where the wastewater enters the treatment plants). Details of the calculation methods are given in the first National Wastewater Drug Monitoring Program report.

1 Information in relation to heroin appears in Report 3.

Collected wastewater samples were analysed at the University of South Australia and the University of Queensland laboratories. The steps routinely performed in our laboratories are based on filtration of the samples followed by an enrichment/concentration step where the concentrated sample is injected, or (for chemicals with sufficiently high concentrations) direct injection of samples into the analytical instruments. The instrumental analysis consists of chromatographic separation and subsequent compound specific detection. A summary of the extraction and analytical methods is given in the first National Wastewater Drug Monitoring Program report. An updated excretion and dose table including the heroin metabolite, 6-monoacetylmorphine, is found in Appendix 1.

3.1. PARTICIPATING WASTEWATER TREATMENT PLANTS (WWTPS)

Forty-five WWTPs across Australia participated in this study for the December 2017 collection (Figure 2). Of these, 20 sites were located in capital cities and a further 25 were regional sites covering a wide range of catchment population sizes. Sites were selected by the ACIC. The number of participating sites for October and December 2017 are listed in Table 2 and Appendix 2. A complete list of participating sites, number of samples and relative catchment sizes are listed in Appendix 3. To maintain the confidentiality of participating sites, all sites were allocated a unique code to de-identify their results. Only site codes are presented in the results sections.

Figure 2: Participating WWTPs in December 2017, showing the split between capital city and regional plants by state and territory. The colours in this figure are used in the remainder of the report to identify results relating to individual states and territories.

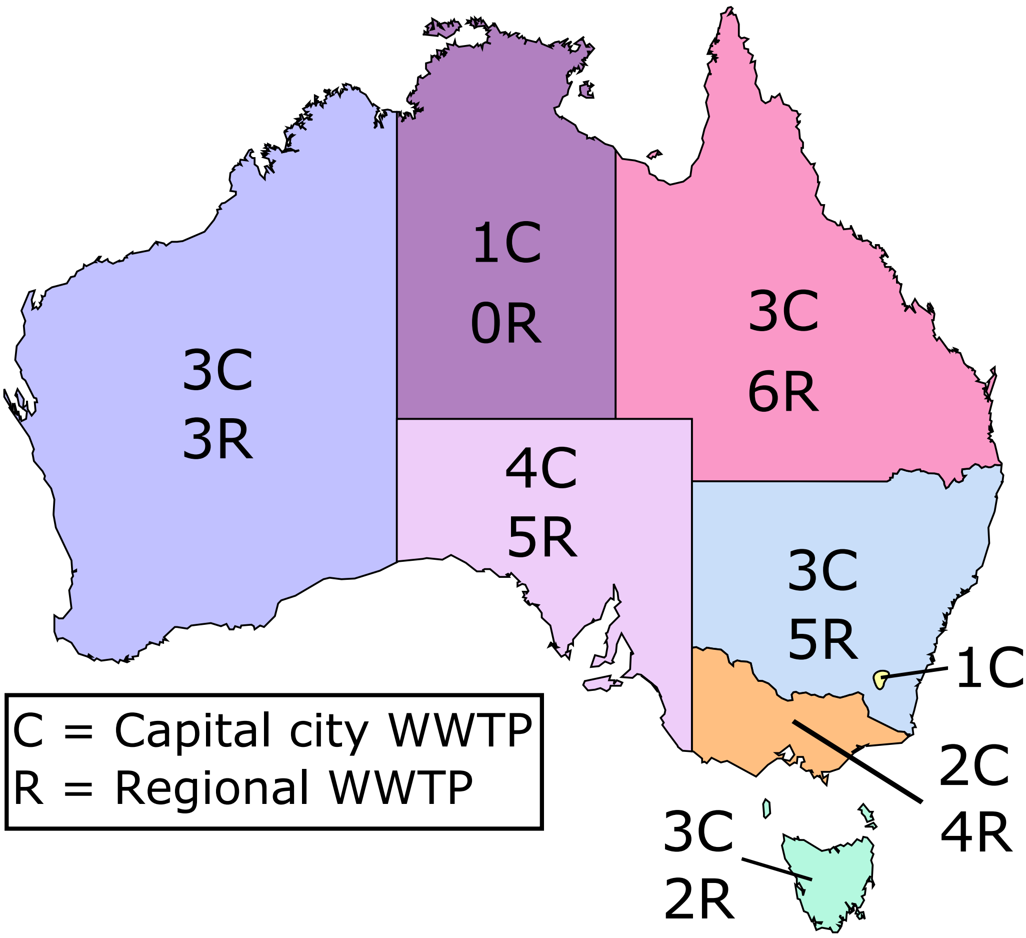


Table 2: Number of participating WWTPs for the periods covered in this report. Every second collection period aims to collect data from both regional (R) and capital city (C) sites (December), while the in-between collection periods (October) aim to collect data from capital city sites only.

	Oct-17		Dec-17	
State/territory	C	R	C	R
ACT	1	–	1	–
NSW	3	–	3	5
NT	–	–	1	–
QLD	3	–	3	6
SA	4	–	4	5
TAS	3	–	3	2
VIC	2	–	2	4
WA	3	–	3	3
Population (millions) C & R	**11.2**	**–**	**11.2**	**1.5**
Total Population (millions)	**11.2**		**12.7**	
% of Australian population	**47.9%**		**54.3%**	

3.2. SAMPLE COLLECTION AND PREPARATION

Composite samples were collected by treatment plant staff daily on seven consecutive days from Monday to Sunday, or where seven days was not feasible, across as many consecutive days as possible. Samples were stored at 4°C or were frozen prior to transport to Adelaide or Brisbane. Further details of the sampling protocol and relevant quality controls are included in Irvine et al. (2011), Lai et al. (2011), Lai et al. (2015), Tscharke et al. (2016). All other descriptions of calculations, extractions and analytical methods are outlined in the first National Wastewater Drug Monitoring report (available at www.acic.gov.au).

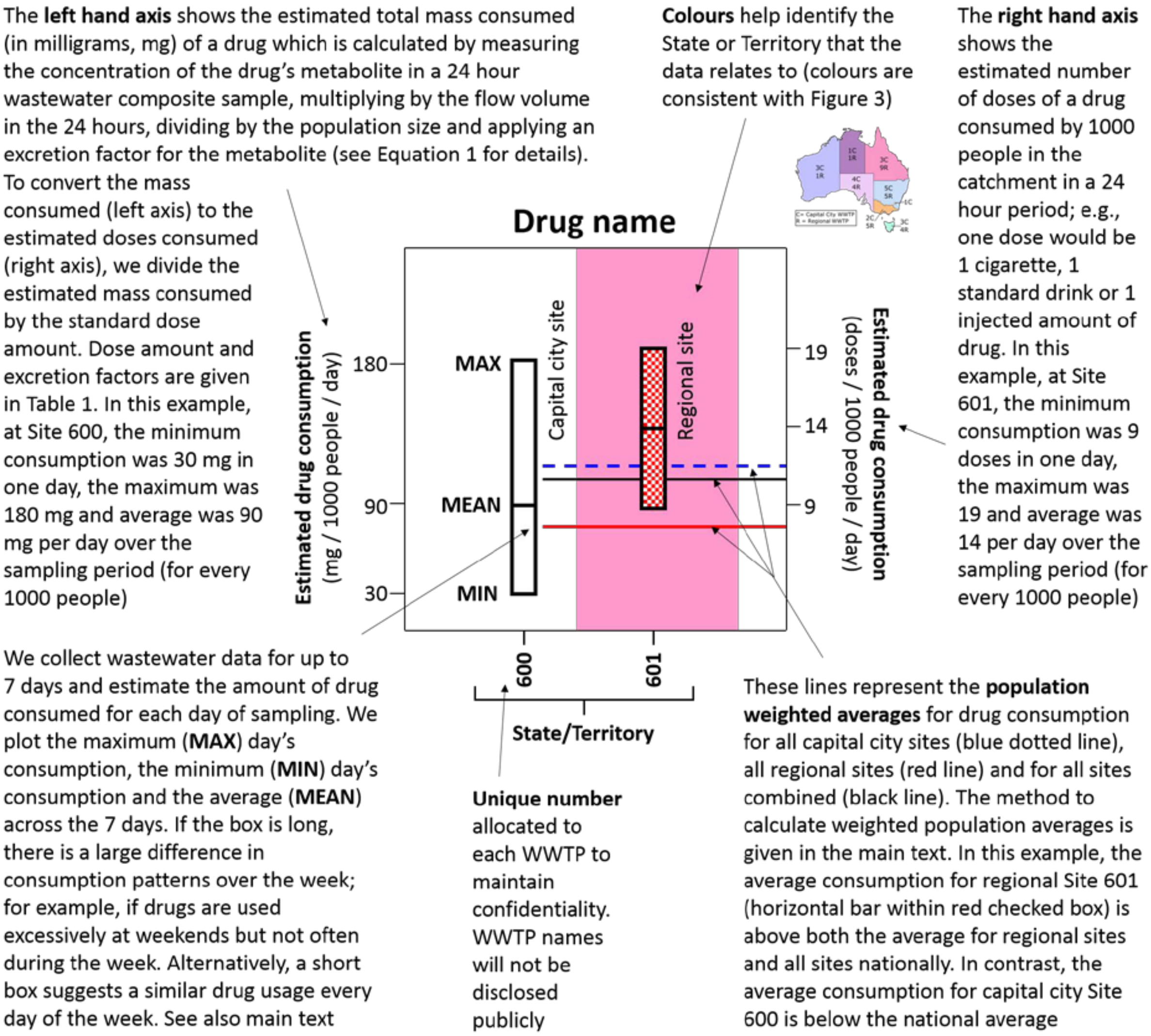
3.3. PRESENTATION OF DATA AND INTERPRETATION OF GRAPHS

Reported averages: All averages for state/territory or Australia-wide drug consumption data are presented throughout this report as population weighted averages. The number of people in the catchment population is used as the weighting for the respective drug consumption data for that population. For example, to calculate the population weighted average of capital city methylamphetamine consumption, the methylamphetamine consumption data for each WWTP was multiplied by the respective population number; all data were then summed and divided by the total population across all capital city sites. Reported average values are therefore not skewed towards usage data from small, non-representative populations.

Per capita consumption: The per capita consumption estimates presented in this report are calculated using the total estimated catchment population (which includes children). For example, per capita alcohol consumption has previously been reported by the Australian Bureau of Statistics (ABS) based on population numbers for people aged 15 and over. The consumption values presented in the current report will be under-estimated compared to those determined for an adult-only population. For consistency, data from other studies included in this report were recalculated where necessary using estimated total population.

Graphical presentation of data: An overview of how the data is presented in the graphs for the individual sites is given in Figure 3. This includes information on interpreting the consumption data presented on the vertical axes in all graphs in this report. In some graphs, the values plotted in the graph can be read as either mass of drug consumed (left axis) or doses of drug consumed (right axis). For the specific case of MDA, the amount of MDA excreted following MDA consumption is not known, and therefore for this drug we can only express the results as how much drug was excreted into the sewer network, e.g. the mg excreted per 1,000 people per day.

Figure 3: Explanation of the graphical representation of data for individual sites. General concepts relevant to all graphs in the report are also outlined (unique site codes, explanation of vertical axes, colour coding).[2]



2 For specific parameters and equations included in Figure 3 see Report 1.

Instrumental method limits of detection and limits of reporting: Since the wastewater samples contain very low quantities of particular drugs, the limit of detection (LOD) was determined analytically as the lowest concentration of that drug that could be distinguished in the sample (using the methods described in Report 1). A drug may be present at a concentration below the LOD. However, trace quantities may actually be present at undetectable levels. The limit of reporting (LOR) is a concentration (higher than the LOD), above which we have high confidence that the concentration measured on the analytical instrument is accurate. Above the LOD but below the LOR there may be some uncertainty as to the actual concentration. To be conservative (a drug may be present but there is uncertainty as to its concentration) and in line with current practice, for back calculations to estimate per capita consumption, a concentration below the LOD is included at a value of LOD. A concentration above the LOD but below LOR is included at the midpoint between the LOD and LOR (i.e. (LOD + LOR)/2).

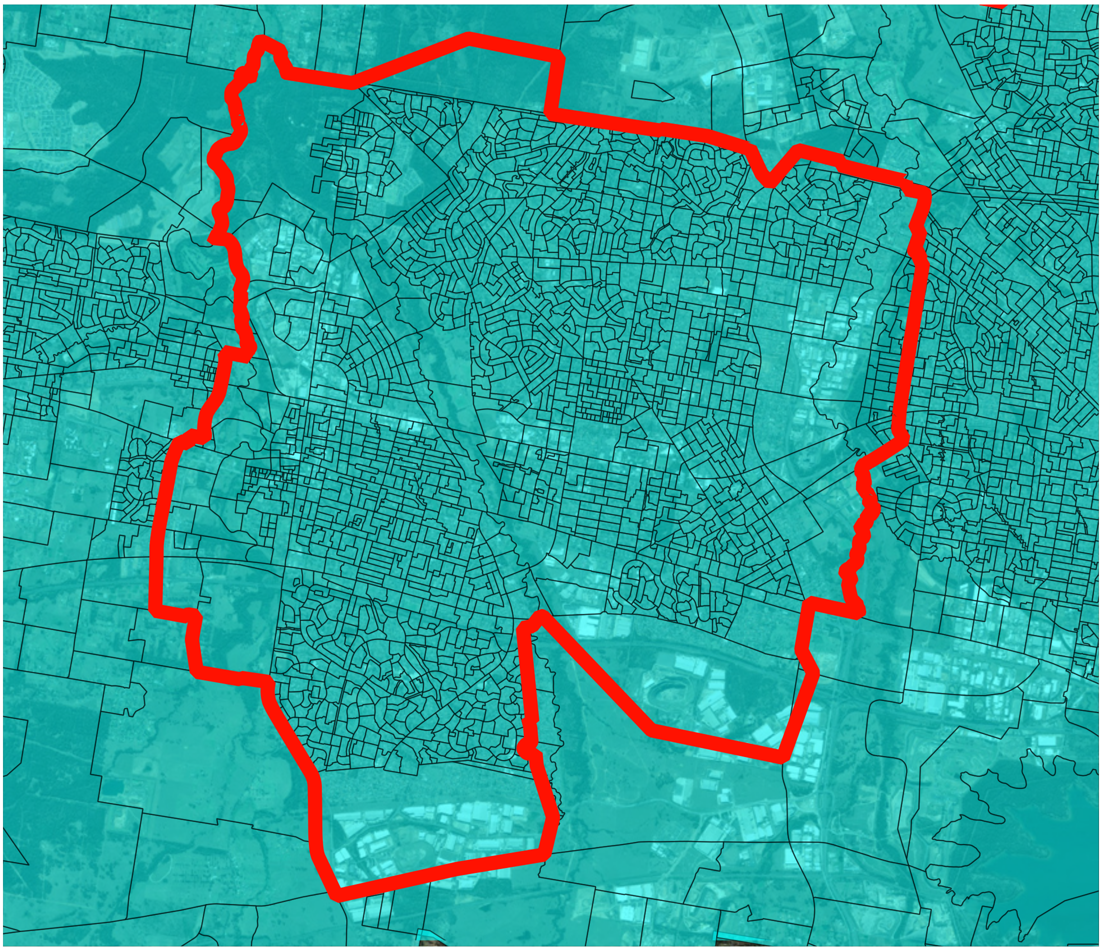
Weekly pattern of drug use: The pattern of drug use over the sampling week for the sites in this report cannot be elucidated from the data included in the current report. We present only maximum, minimum and average (for the individual sites) (Figure 3) and only average (or population weighted average, see above) values for all other graphs. Consistent patterns of drug use in Australia from previous wastewater-based epidemiology studies indicate that some illicit drugs such as cocaine, MDMA, mephedrone and methylone have high variation in weekly consumption rates, with higher consumption on weekends. Other drugs such as methylamphetamine, oxycodone and fentanyl appear to have lower daily variation suggesting that their consumption is consistent throughout the week (Lai et al. 2015, Tscharke et al. 2016).

3.4. REFINING THE WASTEWATER CATCHMENT POPULATION ESTIMATE

In reports one to three, the estimate of the residential population living within the boundary of the wastewater catchments has been provided by the wastewater treatment authorities. These populations have been used to calculate the consumption of substances to units of mg/day/1,000 people or doses/day/1,000 people. These populations have been estimated in various ways, including the number of water connections, the number of municipal wheelie bins within the catchment, the total flow volume received at the treatment plant, plant capacity projections, or the organic nutrient loads within the wastewater. For the first time in this report, we have refined the population estimate using a new methodology, which will increase the accuracy of the population estimate. The catchment maps that were provided by wastewater treatment authorities were geo-referenced (input into GIS software) and merged with the 2016 ABS mesh blocks (the smallest unit of population published by the ABS, typically containing between 30 to 60 dwellings).

An example of a hypothetical catchment, typical of this study, is shown in Figure 4. The population within the overlapping catchment and mesh block areas was summed to provide the population estimate for the catchment. In instances where the mesh block was not contained fully within the catchment boundary, the ratio of the population was estimated based on the proportion of area within the catchment (for instance, if 50 per cent of an individual mesh block area was within the catchment, then 50 per cent of the population of that mesh block was used in the estimate). Overall, an estimate of the possible catchment population undercount or overcount using this estimation method was calculated and is included in Appendix 4. This is discussed further in Appendix 5, along with a diagram. On average, the total population overcount or undercount was very low at around four per cent, indicating a high precision of the refined population estimate method. The resulting population estimates for each catchment are the most accurate using the 2016 Australian Census and should well-reflect the average resident population.

Figure 4: Example catchment boundary map (red line) and ABS mesh block data (black lines) layered on top of Google satellite imagery (background). Note: map does not depict a real wastewater catchment.



4: RESULTS

Estimated drug consumption data are presented in several different ways in the following sections to allow comparisons of drug use at the individual site level (Section 4.1), between states and territories (Section 4.2) and within each state and territory (Section 4.3). We recommend exercising caution when comparing results between sites. A list of the detection frequency for each drug is found in Appendix 6. For this report we have refined the current population estimates for higher accuracy by integrating the specific wastewater catchment areas against the high-resolution population data recently released from the 2016 Census. The uncertainties in individual population estimates have less impact when data are averaged, for example when broader comparisons at the state/territory or international level are undertaken. The uncertainties in population numbers are particularly evident in smaller regional communities or sites where short-term population changes occur due to employment opportunities, tourism or festival events.

4.1. INDIVIDUAL SITE COMPARISON OF DRUG USE IN DECEMBER 2017

4.1.1 NICOTINE AND ALCOHOL

Tobacco consumption was estimated by measuring two nicotine metabolites. The method does not distinguish between nicotine intake from tobacco or electronic cigarettes and nicotine replacement therapies, such as patches and gums. Therefore, for the sake of accuracy, the estimate is reported as nicotine in this report. Estimated nicotine consumption varied significantly between sites and regions (Figure 5). Sites in regional areas across all states and territories showed noticeably higher per capita consumption levels during December 2017 than capital city precincts. This was evident from the regional vs. capital city averages for the December sampling period (red horizontal and dotted blue lines, Figure 5). South Australia was the only region where consumption in capital city sites matched rural levels.

Alcohol was measured using a specific metabolite of ethanol. Differences between the average capital city and regional centre alcohol consumption were less pronounced than for nicotine (Figure 6). Many sites showed a wide range over the collection week. Alcohol consumption in some regional areas of Western Australia, South Australia and parts of Queensland were well below the national average. However, many regional sites did not sample on weekends, when consumption of alcohol is typically higher. The Northern Territory, capital sites of Tasmania and a couple of Western Australian sites were above the national capital city and regional averages.

Figure 5: Estimated nicotine consumption for December 2017 in mass of nicotine consumed per day (left axis) and number of cigarettes per day (right axis) per thousand people. The number of collection days varied from 4–7.

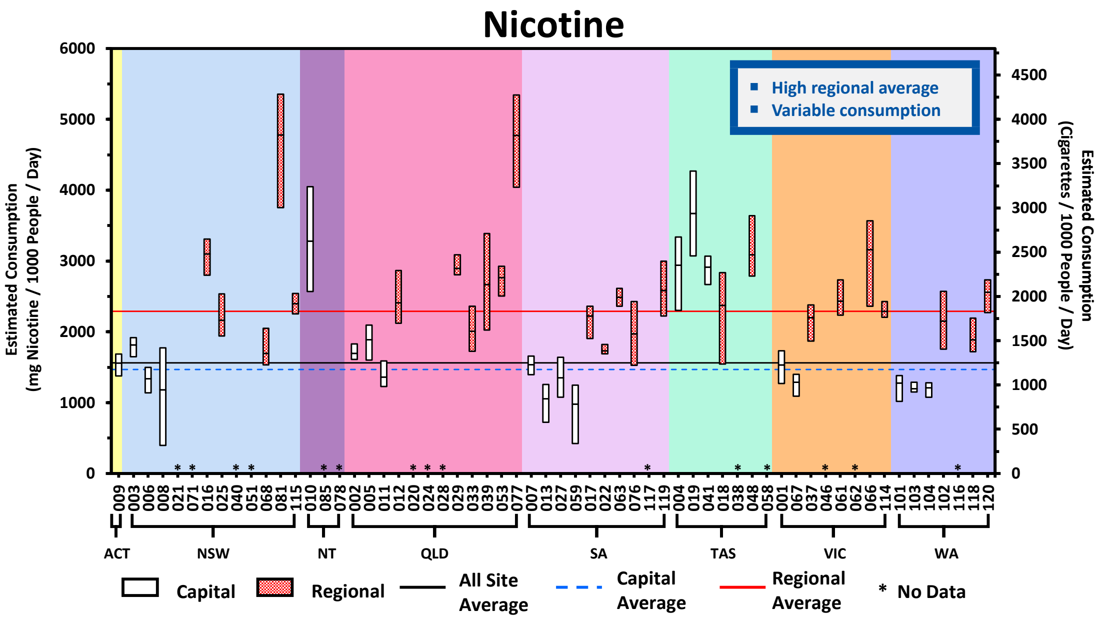
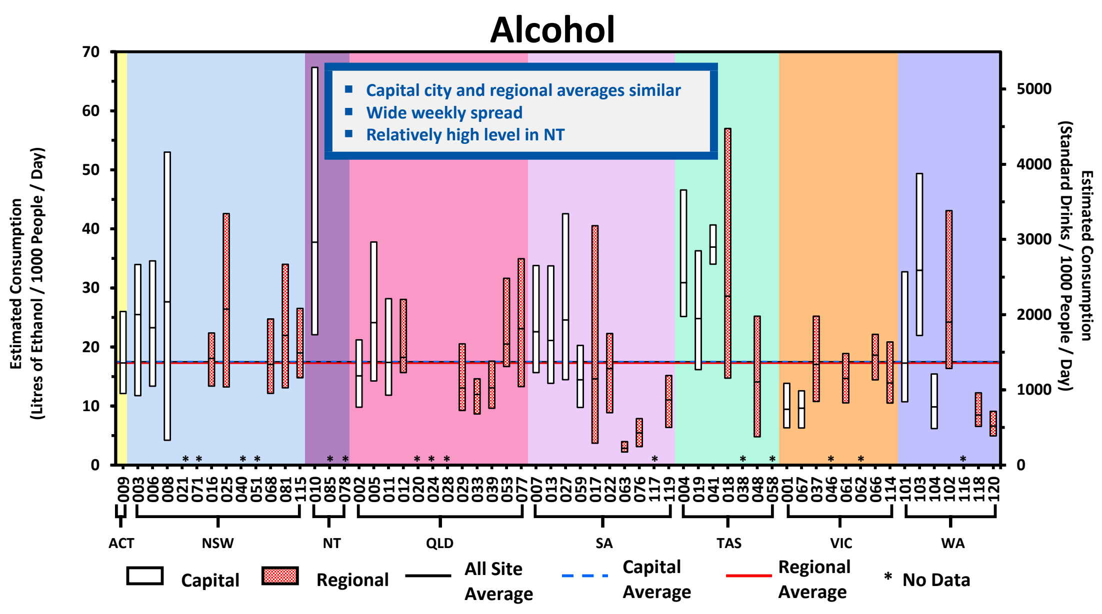


Figure 6: Estimated alcohol consumption for December 2017 in volume consumed per day (left axis) and standard drinks per day (right axis) per thousand people. The number of collection days varied from 4–7.



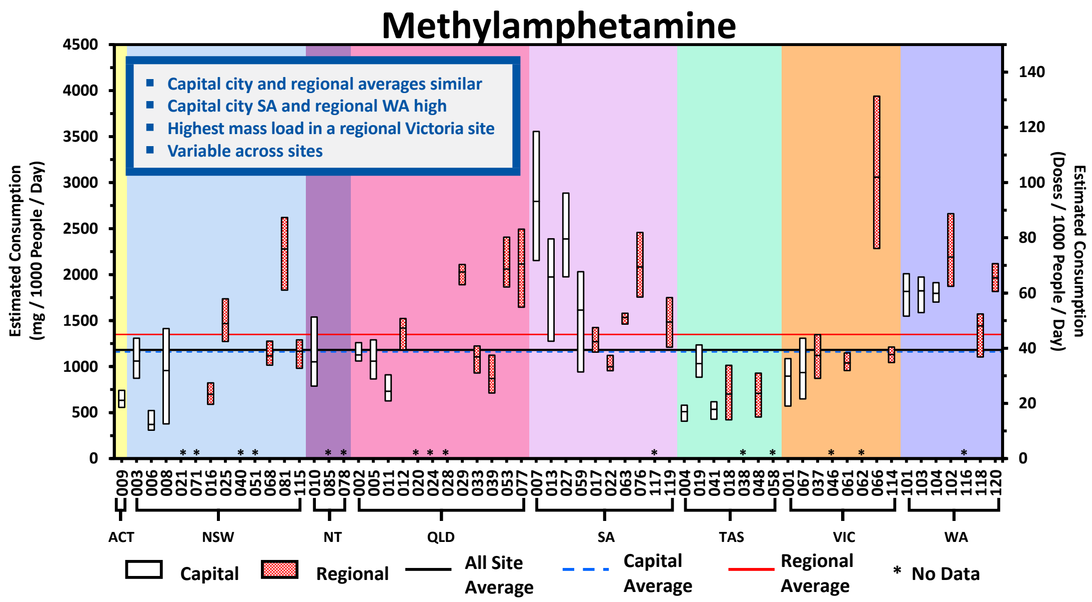
4.1.2 STIMULANTS

The relative estimated consumption levels across the participating sites for four stimulants—methylamphetamine, cocaine, MDMA and MDA—are described in more detail below.

4.1.2.1 METHYLAMPHETAMINE

Estimated mass loads of methylamphetamine were high compared to other illicit substances. The average regional and capital city consumption were at similar levels. However, large site differences were evident. The high variability in consumption was observed across all states. Mass loads in capital city South Australia were the highest in the nation in December 2017 (Figure 7), while a site in Victoria had the highest regional mass load.

Figure 7: Estimated methylamphetamine consumption for December 2017 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 4–7.



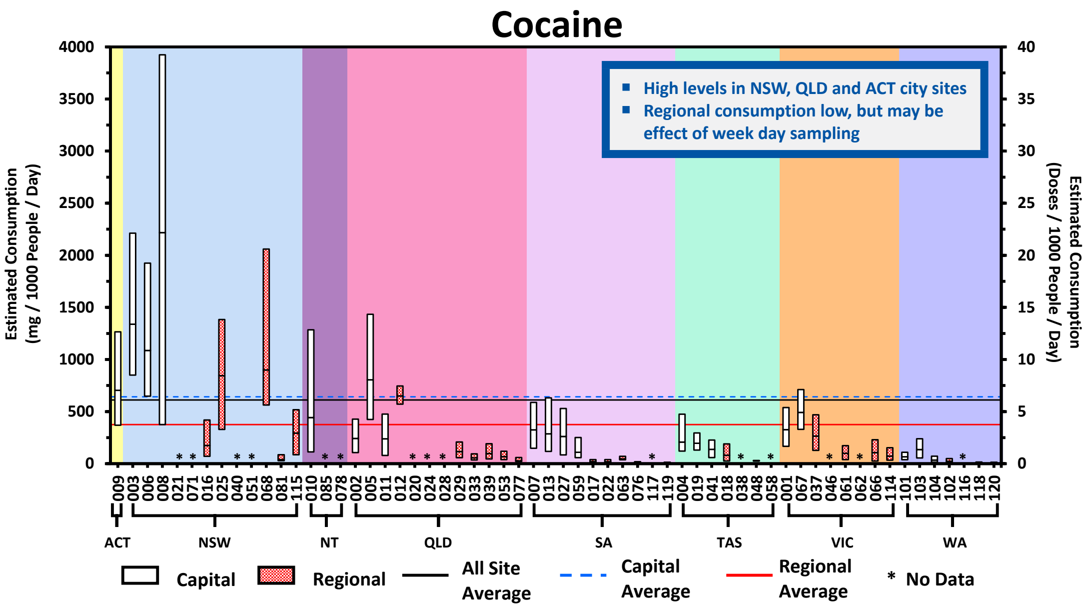
4.1.2.2 AMPHETAMINE

The concentration of amphetamine observed in the August 2016 and December 2017 samples strongly correlated with the methylamphetamine concentrations, with approximately seven times higher methylamphetamine measured than amphetamine for both periods (see Appendix 4 of Report 1) which is consistent with the reported amphetamine excretion range following methylamphetamine consumption (Gracia-Lor et al. 2016). Therefore, we assumed that the levels of amphetamine measured were predominantly metabolites of methylamphetamine. It is possible that some of the amphetamine measured could be a result of amphetamine ingestion, but due to the much higher methylamphetamine consumption and excretion profile, this cannot be confirmed by our present data.

4.1.2.3 COCAINE

Cocaine was measured using its specific metabolite, benzoylecgonine. Unlike methylamphetamine, capital city areas on average had higher cocaine use than regional centres (Figure 8). However, it has to be recognised that many regional sites did not provide weekend samples, unlike capital cities, when consumption of cocaine is known to peak (Lai et al., 2016 and Tscharke et al., 2016). Western Australia had relatively low consumption in both regional and capital city areas. In contrast, capital city New South Wales showed the highest levels nationwide, while consumption in regional parts of the state was also higher than the national average. Nevertheless, the scale of cocaine use in Australia remained noticeably lower than methylamphetamine levels.

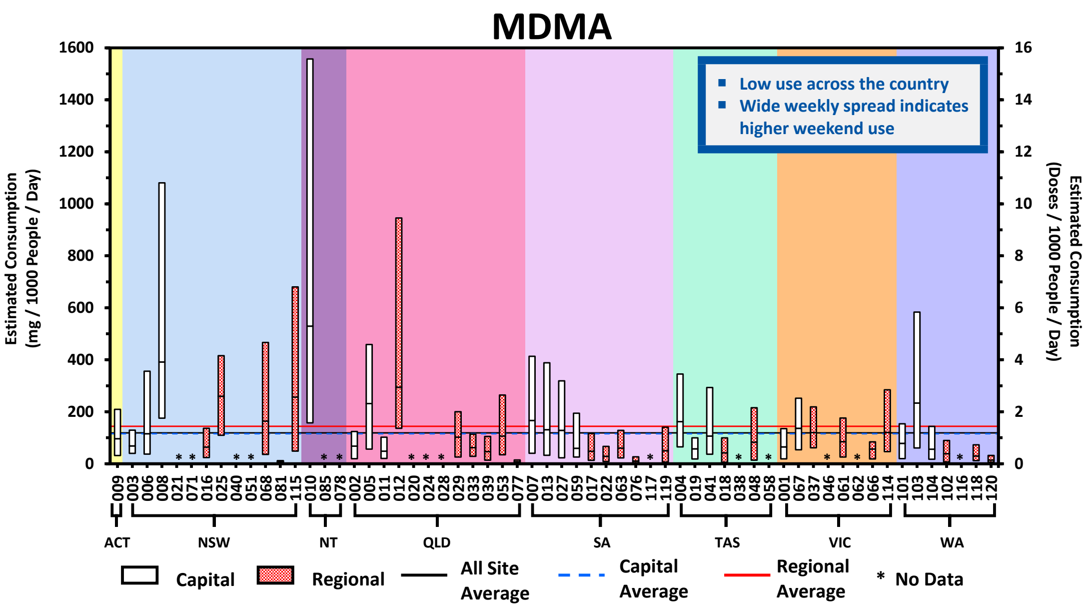
Figure 8: Estimated cocaine consumption for December 2017 in mass consumed per day per thousand people (left axis) and doses per day (right axis). The number of collection days varied from 4-7.



4.1.2.4 MDMA (3,4-METHYLENEDIOXYMETHYLAMPHETAMINE)

In comparison with other illicit substances, estimated consumption of MDMA was low across the country (Figure 9). Site 10 in capital city Northern Territory had relatively high levels on some days of the week, but in general, levels were comparable across the nation. The regional average was slightly lower than capital city sites. A direct comparison of regional and capital city sites in some states (e.g. South Australia) may be inappropriate, as many regional sites did not sample on weekends when MDMA consumption is typically higher.

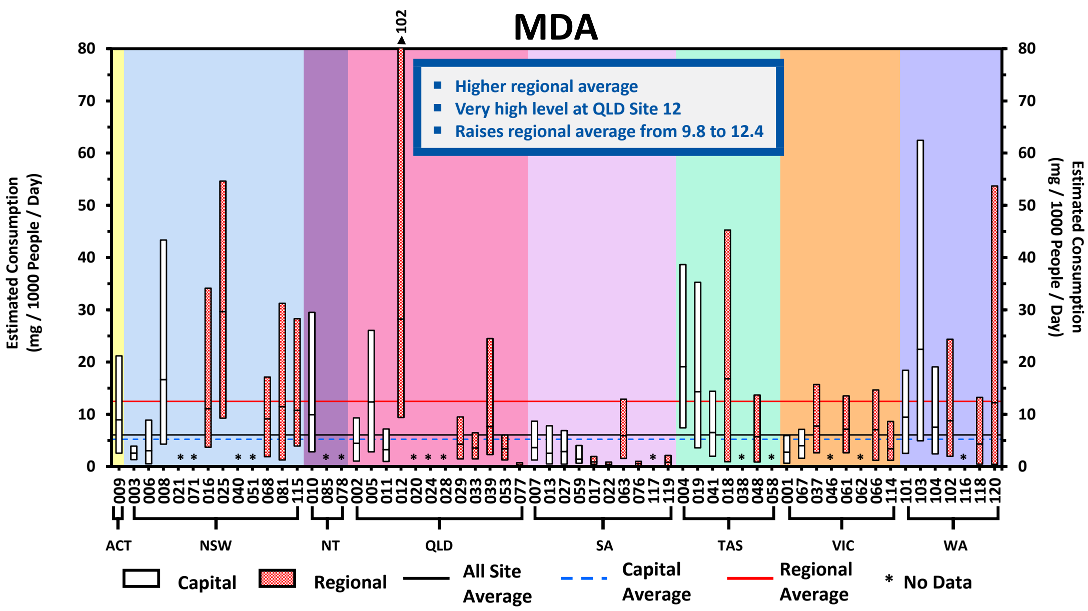
Figure 9: Estimated MDMA consumption for December 2017 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 4–7.



4.1.2.5 MDA (3,4-METHYLENEDIOXYAMPHETAMINE)

MDA previously had low overall detection frequency using a direct injection method. In this latest report, the compound was detected after concentrating the sample using solid phase extraction (SPE) prior to analysis to improve the sensitivity of the method. Data is not available in the scientific literature for the proportion of MDA that is eliminated after MDA consumption. However, data is available detailing the proportion of MDA eliminated after MDMA consumption. Therefore, the proportion of MDA attributable from MDMA metabolism was subtracted from the total measured amount of MDA for each site. Data for MDA is expressed as mg excreted per 1,000 people per day and cannot be expressed as consumption due to the lack of metabolic information of MDA elimination following MDA consumption. Although the dosage of MDA is not known, it is likely to be similar to that of MDMA, of around 100 mg. The daily mass loads for regional sites were on average higher than capital cities (Figure 10). Site 12 in Queensland had very high levels compared to other sites in the state and elsewhere and may have distorted the average value for regional centres. Since the parent drug is measured in wastewater, disposal of unused drug into the sewer system may result in unusually high values being recorded. South Australia generally had the lowest levels of MDA, both in regional and capital city centres.

Figure 10: Estimated MDA consumption for December 2017 in mass consumed per day per thousand people. The number of collection days varied from 4-7.



The arrow above the graph indicates the maximum of QLD Site 012. The axes remain at a smaller value to allow comparison between areas of lower MDA excretion.

4.1.3 OPIOIDS

Two pharmaceutical opioids were measured, as well as heroin, an illicit drug.

4.1.3.1 PHARMACEUTICAL OPIOIDS

Although oxycodone and fentanyl are legally prescribed pharmaceuticals, they are substances with abuse potential. The metabolism and excretion of both compounds are well characterised. The major metabolite of each compound was measured to estimate drug consumption.

Consumption of oxycodone in regional sites was well above capital city levels, with the regional national average being higher than that of the capital cities (Figure 11). Regional Queensland and parts of Tasmania and Victoria were amongst the highest overall users of oxycodone, while Tasmania was highest of the capital city sites and Victoria the highest of the regional sites.

The extent of fentanyl use was very variable across the nation. Some regional centres in almost every state had values well above the national average (Figure 12). Two locations in particular, Site 81 and Site 16 in New South Wales, gave values that were almost 2–3 fold higher than the next highest measurement. Except for Tasmania, regional consumption was substantially higher than capital city areas. Rates of fentanyl use in capital cities across Australia were of comparable levels, with relatively small differences in per capita consumption per day between sites.

Figure 11: Estimated oxycodone consumption for December 2017 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 4–7.

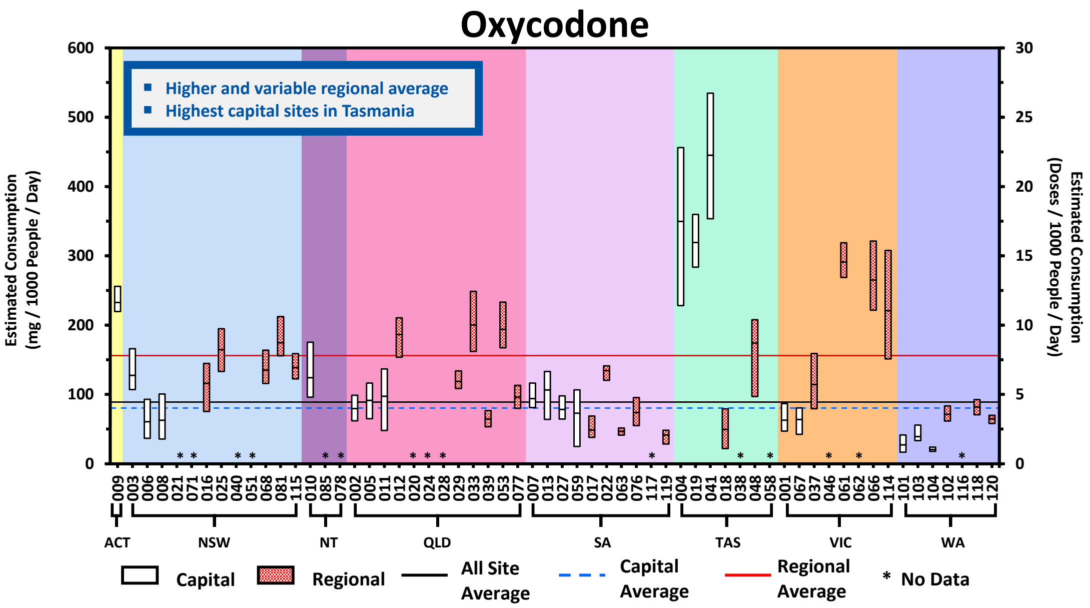
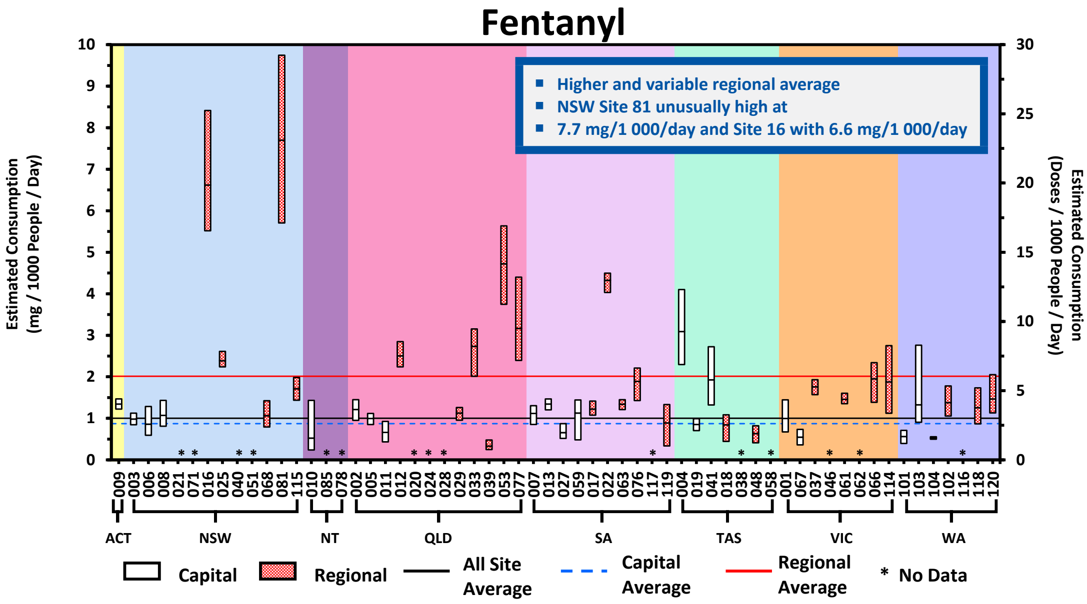


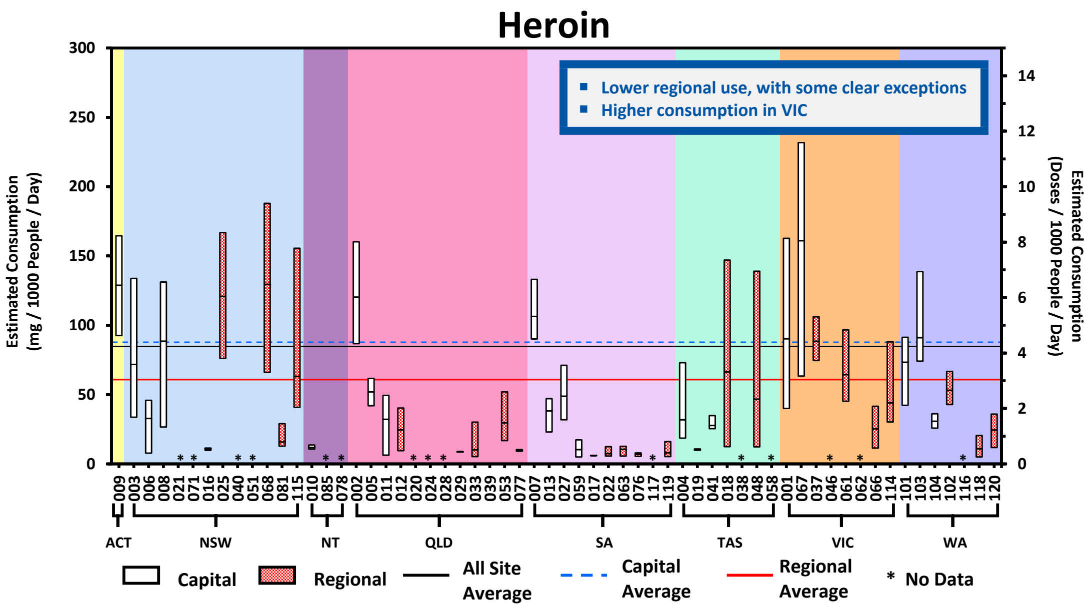
Figure 12: Estimated fentanyl consumption for December 2017 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 4–7.



4.1.3.2 HEROIN

Heroin is metabolised by users and excreted in low amounts as the unique metabolite, 6-monoacetylmorphine (6-MAM). A method to detect heroin by 6-monoacetylmorphine was described in a paper by Tscharke et al., 2016. Since 6-MAM is characteristic of heroin use, it can be used to distinguish heroin from other opioids such as morphine and codeine. Heroin consumption in Australia in December 2017 was relatively low (Figure 13). Some regional areas of Tasmania and New South Wales recorded the highest levels of all measured locations. South Australia remains lower nationally.

Figure 13: Estimated heroin consumption for December 2017 in mass consumed per day (left axis) and doses per day (right axis) per thousand people. The number of collection days varied from 4–7.



4.1.4 NEW PSYCHOACTIVE SUBSTANCES

Methylone and mephedrone were included in the study. Limited information is available on the human metabolism and excretion of these drugs. Therefore, the parent compound was measured. It is probable that a significant proportion of the ingested drug is converted into different metabolites. Apart from sporadic instances of methylone detections in Queensland, only a few sites showed evidence of methylone and mephedrone use. The measured levels were mostly below the limits of reporting. Sites that showed the presence of the two compounds are qualitatively listed in Table 3 for the December 2017 period. The temporal changes in detections per state (number of samples above LOD) are shown in Figure 14.

Table 3. The number and code of sites per state and territory where mephedrone and methylone were detected in December 2017. The total number of daily samples that were assessed was 288.

	Number of detections Dec 2017		Sites detected Dec 2017	
State/territory	**Mephedrone**	**Methylone**	**Mephedrone**	**Methylone**
NT	0	3		010
ACT	0	1		009
NSW	18	31	006, 008, 068	003, 006, 008, 016, 025, 068, 115
QLD	5	10	002, 012, 029	005, 012
SA	0	4		063
TAS	0	3		018
VIC	0	13		001, 067, 061, 114
WA	0	0		
Total	**23**	**65**		

Figure 14: The percentage of all samples where mephedrone and methylone were detected.

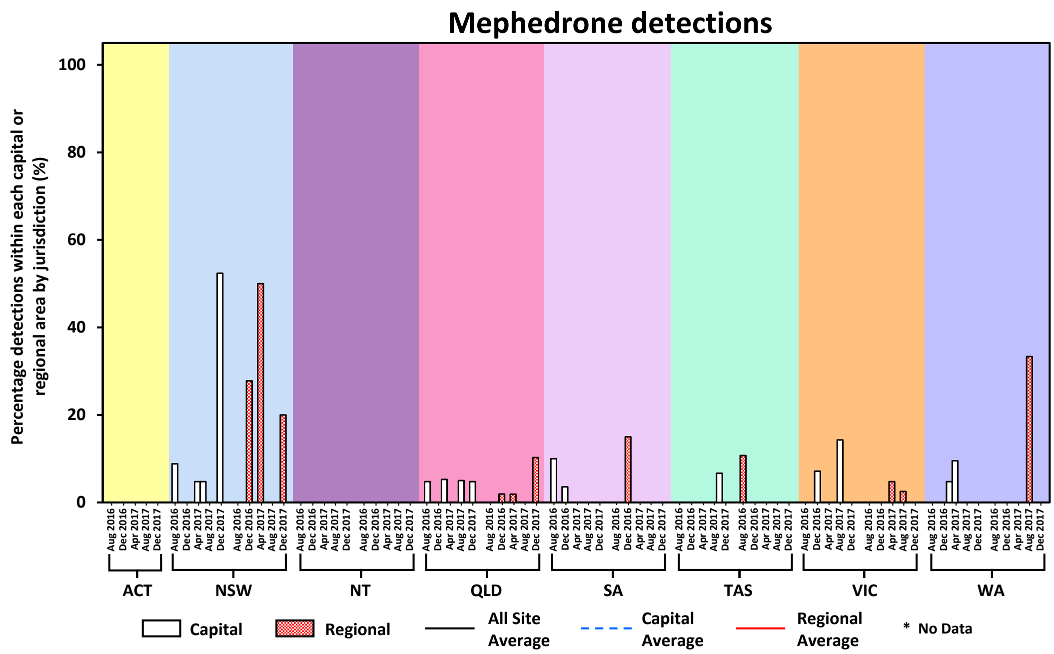
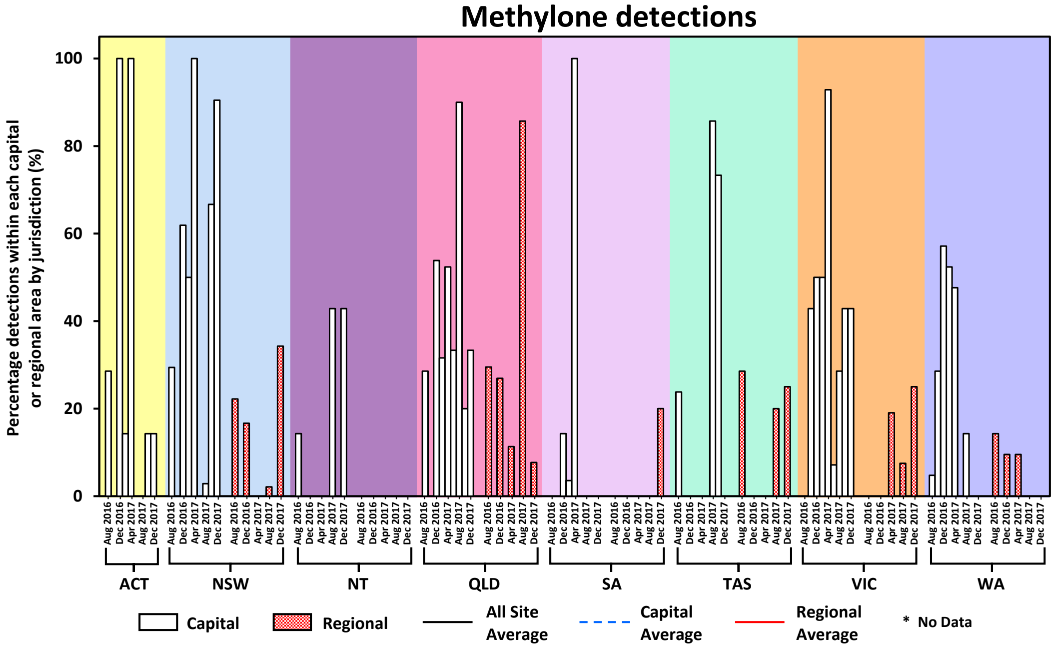
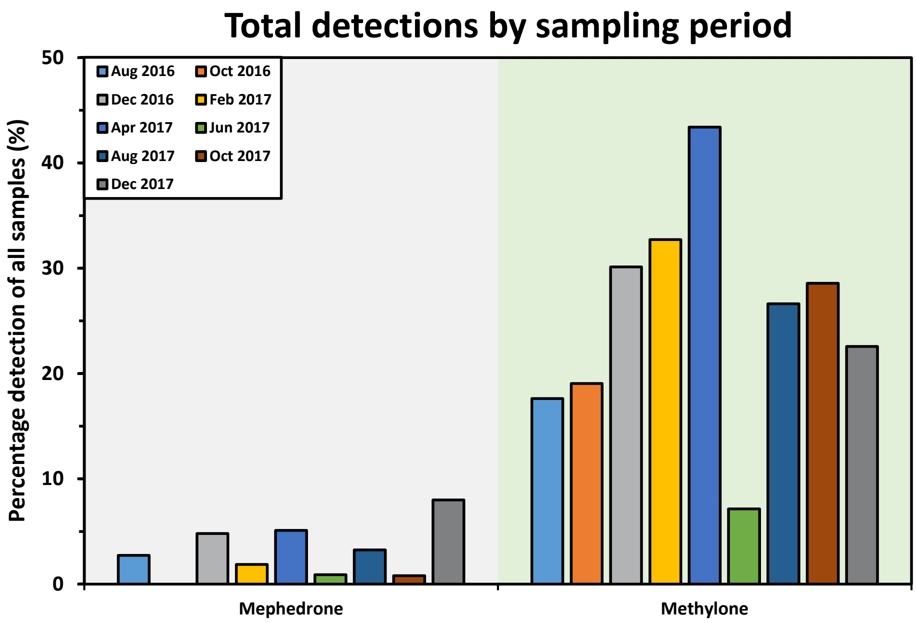


Figure 14 (continued): The percentage of all samples where mephedrone and methylone were detected.





4.2. STATE AND TERRITORY COMPARISON OF DRUG USE

The total level of each drug outlined in the preceding reports per state or territory was compared with subsequent collection periods included in the current report. Every effort was made to assess the same sites for each period. However, as the individual sites and the number of sites used to generate the population-weighted averages may have changed between periods, comparing between time points should be done with caution. This would be most evident for the regional averages, which had more variation in participation between each period (see Appendix 3 for a comprehensive list of participating sites and number of days assessed per sampling campaign). Note: the lines on each graph representing averages are the cumulative average across all sampling time points.

4.2.1 NICOTINE AND ALCOHOL

Average nicotine consumption in samples collected from regional sites was generally higher when compared to the capital cities (Figure 15). In some states and territories, nicotine consumption showed steady levels over the total collection periods. Western Australia showed an overall decrease for both capital city and regional areas. In the case of alcohol, the difference between overall capital city and regional centre consumption within each state or territory was less pronounced, except for South Australia, where regional use is almost half that of the capital city (Figure 16). For the most part, consumption levels remained steady with no apparent trend in terms of changes in use over time within each region.

Figure 15: Estimated average consumption of nicotine by state/territory, where 1 cigarette contains 1.25 mg of nicotine.

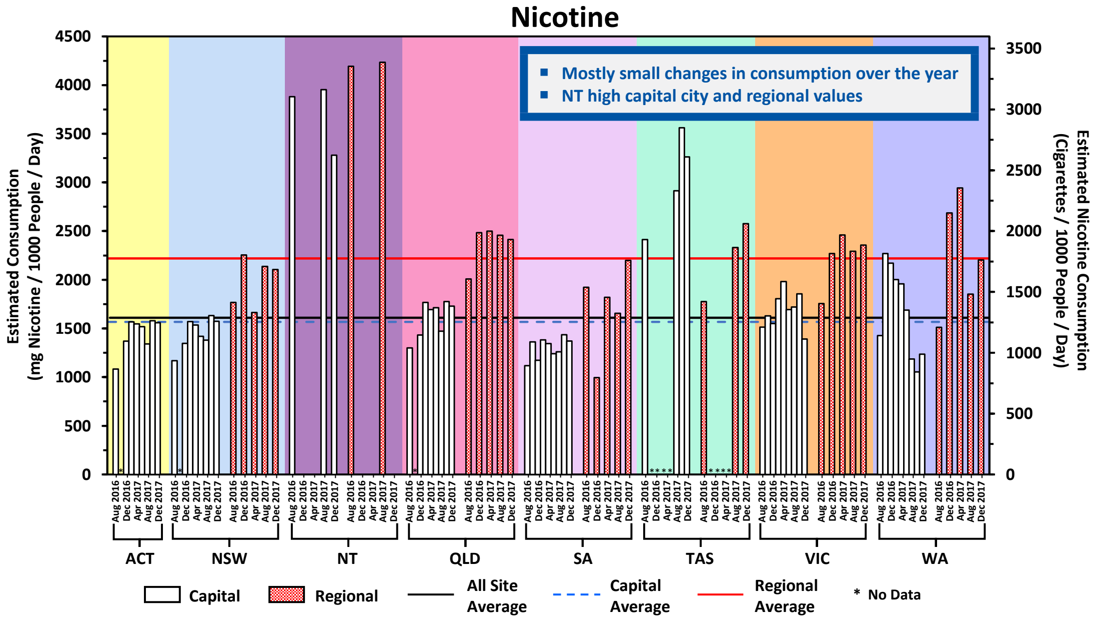
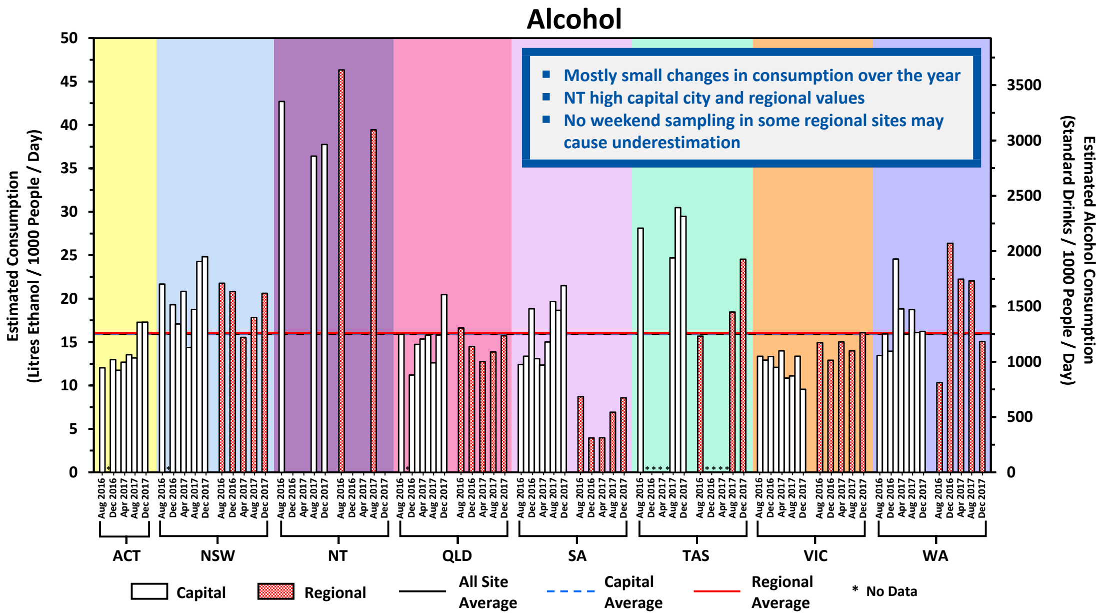


Figure 16: Estimated average consumption of alcohol by state/territory. A standard drink is 10.0 g or 12.5 mL.



4.2.2 ILLICIT DRUGS

The trend in methylamphetamine use was variable in many parts of the country (Figure 17). Consumption in the Australian Capital Territory, New South Wales, Tasmanian and Victoria remains stable, while Queensland is increasing, particularly in city sites. South Australia had the highest capital city consumption, but no clear trend was apparent. Western Australia had the highest regional levels of methylamphetamine consumption.

When plotted against historical levels recorded in the three regions, the previously described decline or levelling off in methylamphetamine consumption in South Australia was largely maintained, while Western Australia is increasing. Levels in Victoria showed a decline (Site 67) or remained steady (Site 1) over the current and historical periods (Figure 18). It is not yet clear whether these are part of longer term trends.

Figure 17: Estimated average consumption of methylamphetamine by state/territory.

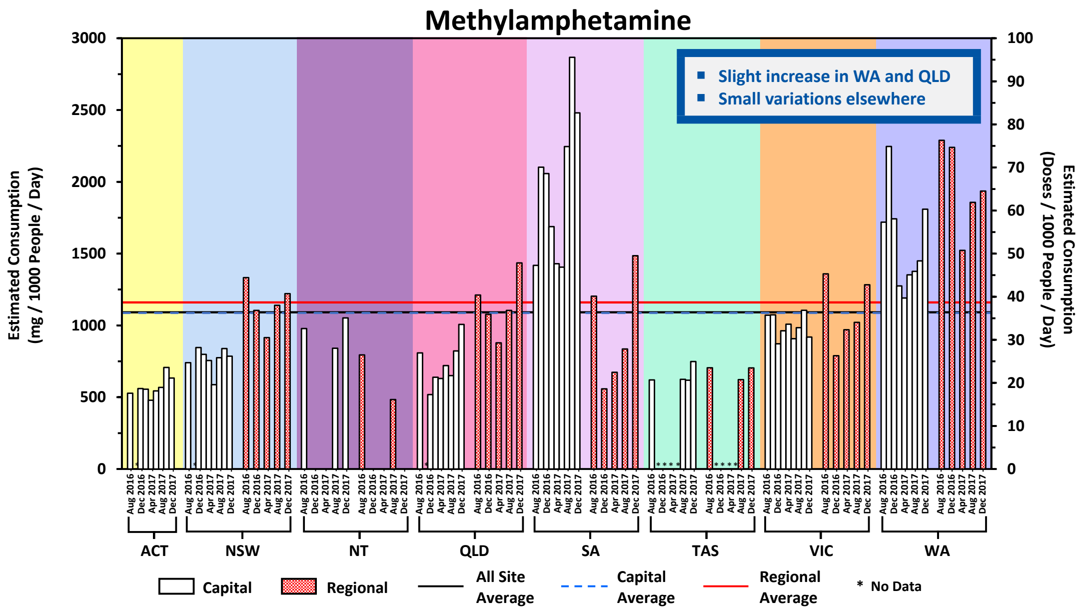


Figure 18: Change in methylamphetamine consumption for sites with historical data.

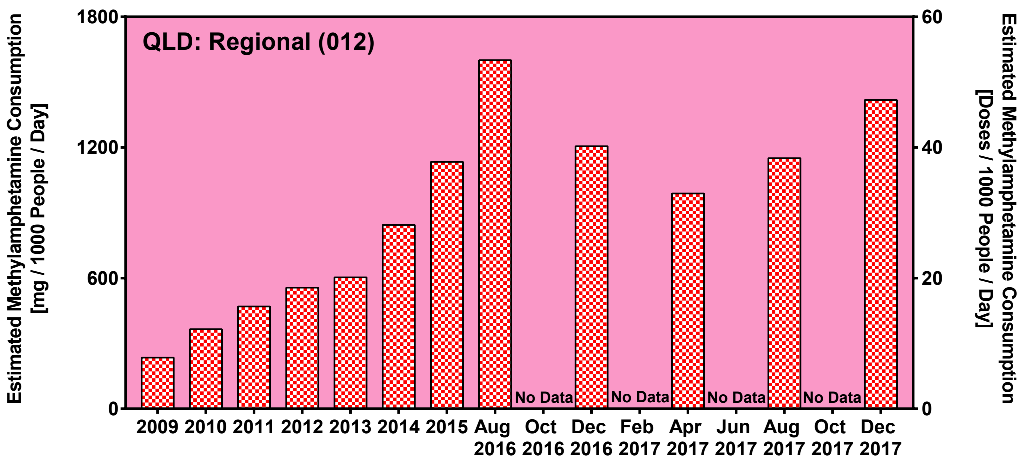


Figure 18 (continued): Change in methylamphetamine consumption for sites with historical data.

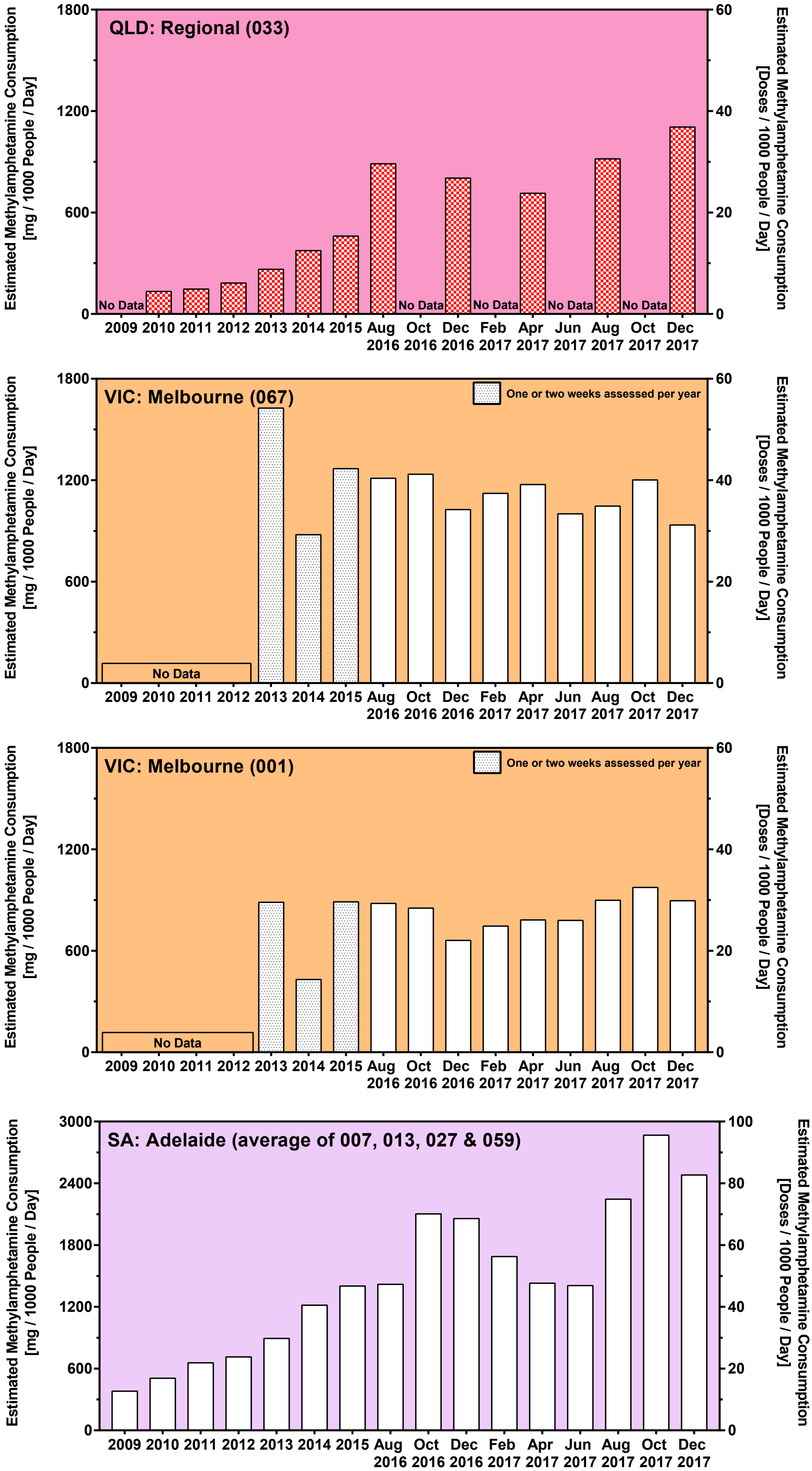
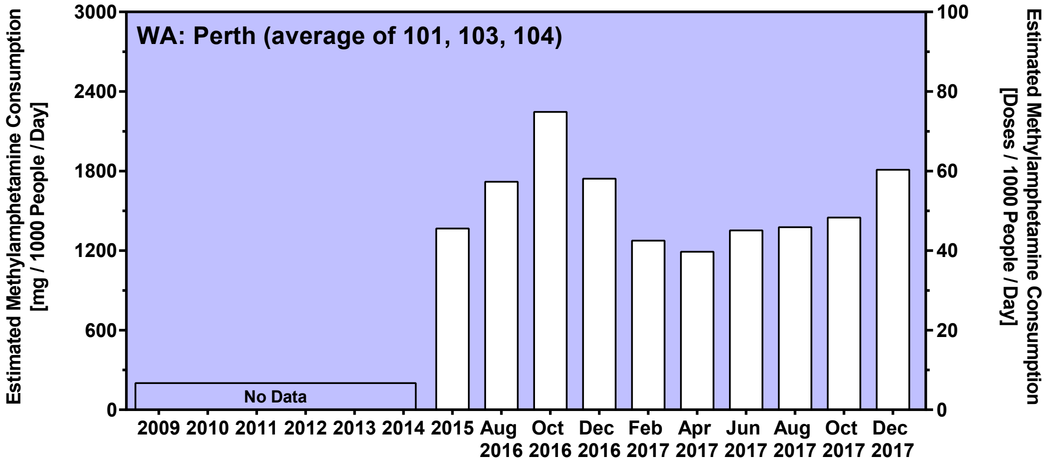
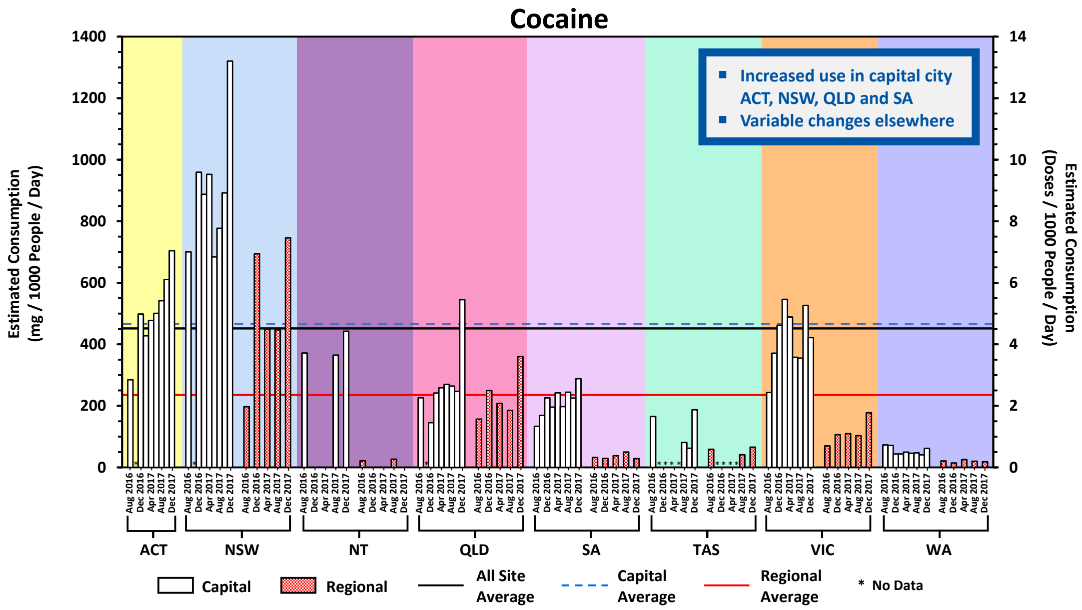


Figure 18 (continued): Change in methylamphetamine consumption for sites with historical data.



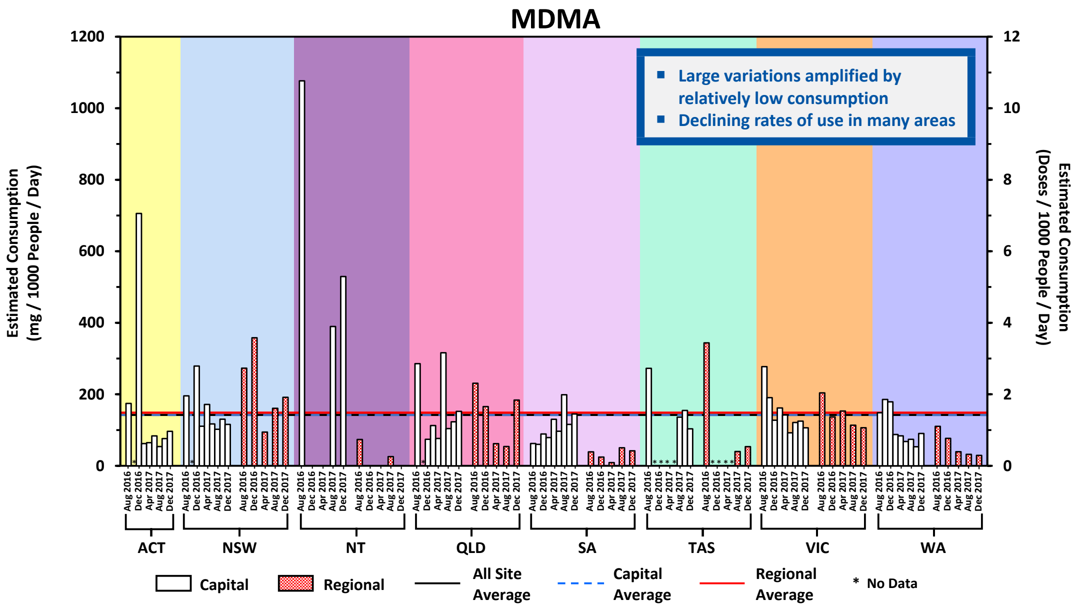
The consumption of cocaine in capital city sites in New South Wales remained high for the duration of the monitoring period compared to other Australian regions (Figure 19). The upward trend in consumption observed in the previous report for the Australian Capital Territory continued after April 2017. Small increases were evident in other states, but these are from a very low base. Regional consumption was noticeably lower than in capital cities in every state and territory, except Queensland. Western Australia and Tasmania remained well below the national average.

Figure 19: Estimated average consumption of cocaine by state/territory.



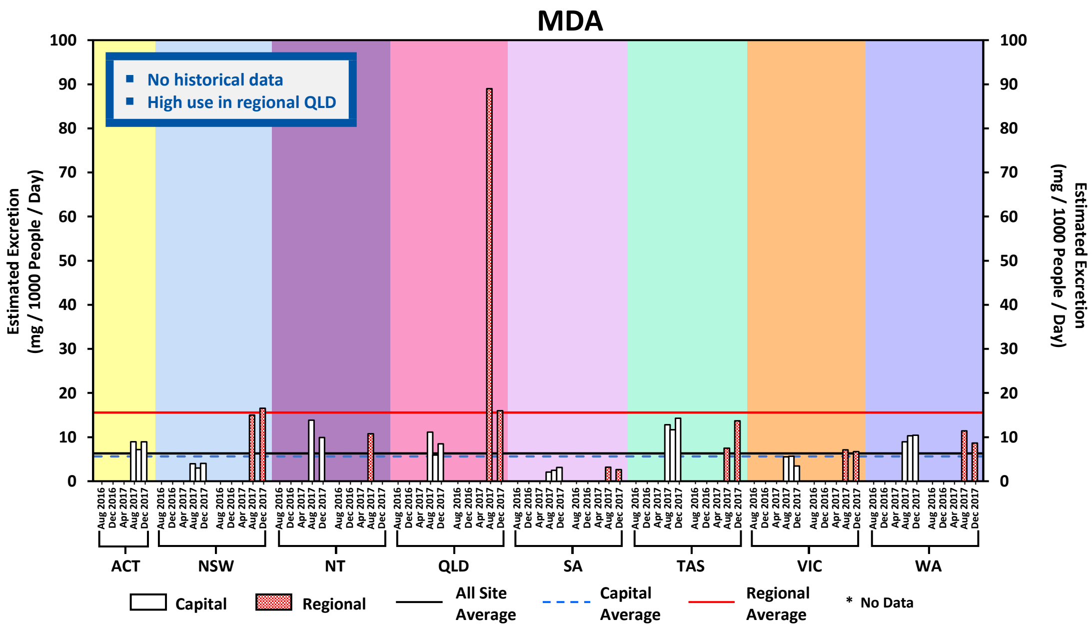
MDMA use in Australia appeared to be on the decline in all states and territories, except the South Australian capital city region (Figure 20). Use in the Northern Territory remained high compared to other parts of the country, but the August 2017 figure was well down on the initial value recorded a year ago. Regional centres showed levels slightly below the capital city locations. However, this may be attributable to some regional sites not providing weekend samples, when consumption is typically higher. The actual trend would not be affected by sampling day and is a reasonable measure of changes in consumption over the study period.

Figure 20: Estimated average consumption of MDMA by state/territory.



MDA use, corrected for the proportion derived from MDMA (Khan & Nicell 2011), showed that regional Queensland had the highest levels, while most other states and territories were very similar (Figure 21). South Australia and capital city New South Wales were at levels below average. The regional and overall national averages were skewed somewhat by the high MDA levels detected at Site 012 in Queensland.

Figure 21: Estimated average consumption of MDA by state/territory.



4.2.3 OPIOIDS

The average levels of oxycodone and fentanyl use were higher in regional areas of a number of states (Figure 22 and Figure 23). Since the first report in March 2017, which contained analysis of samples collected in August 2016, consumption of the pharmaceutical opioids declined in some regions; for example, regional New South Wales, South Australia and Western Australia. Capital cities of the Australian Capital Territory and Tasmania showed an increase in consumption, particularly for oxycodone. Some fluctuations in use were evident for the most part in other states and territories. The variation in participating rural sites (and hence the sampled populations) may also have an effect on the observed trend of the population-weighted averages.

Figure 22: Estimated average consumption of oxycodone by state/territory.

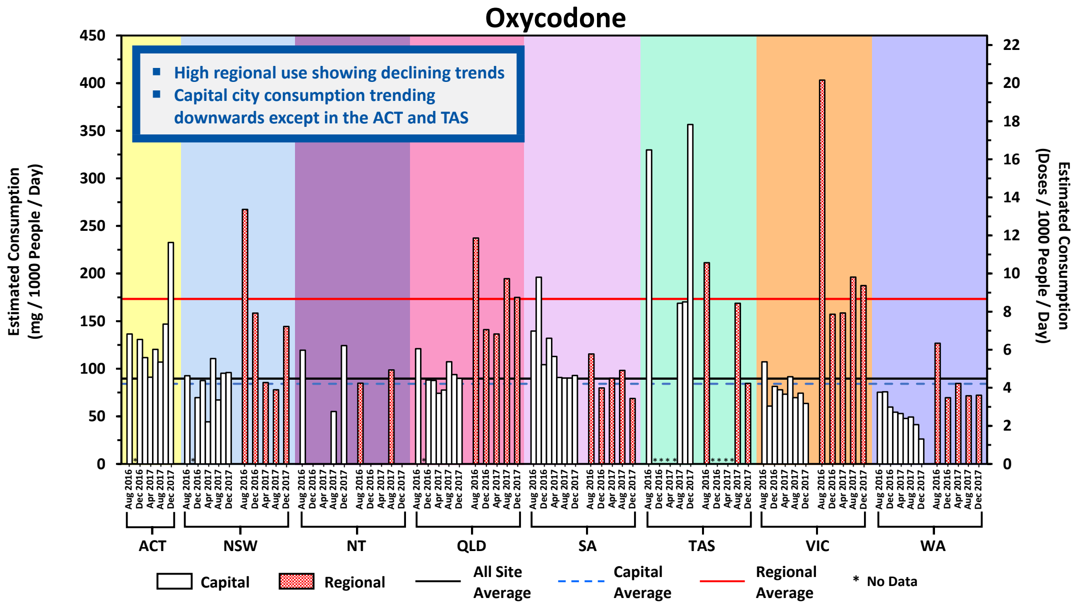
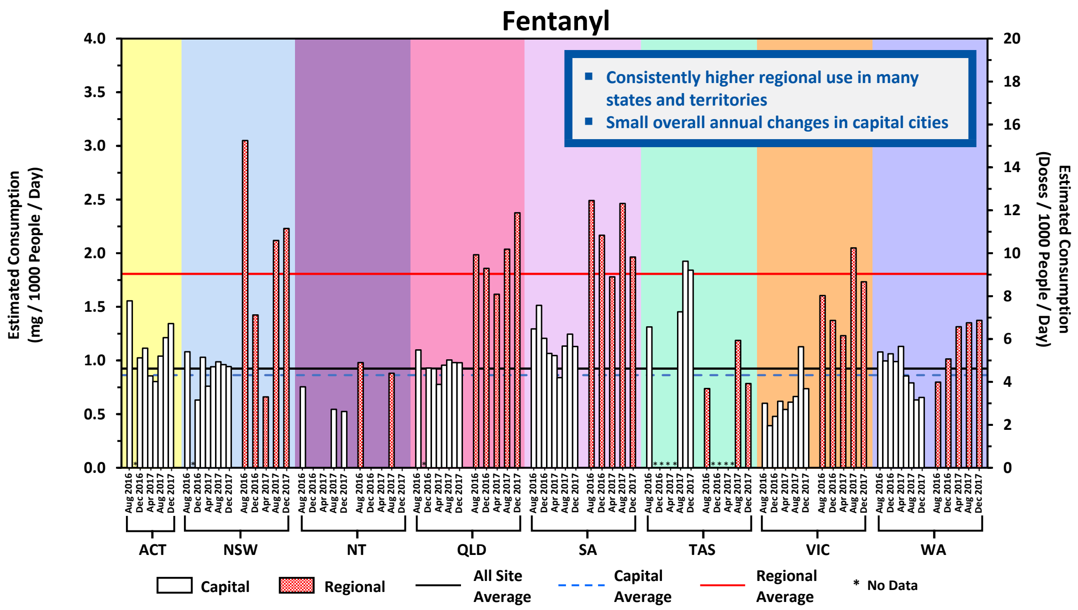


Figure 23: Estimated average consumption of fentanyl by state/territory.



While heroin was included for the second time and historical data are lacking for most sites, a state and territory comparison of the use of the substance showed that consumption was highest in Victoria (Figure 24). In general, regional areas of each state had lower levels of heroin use, with New South Wales the only exception. The extent of heroin consumption has been measured in capital city South Australia since 2013. Together with the current reporting period, levels of heroin consumption for the region have been slightly declining (Figure 25).

Figure 24: Estimated average consumption of heroin by state/territory.

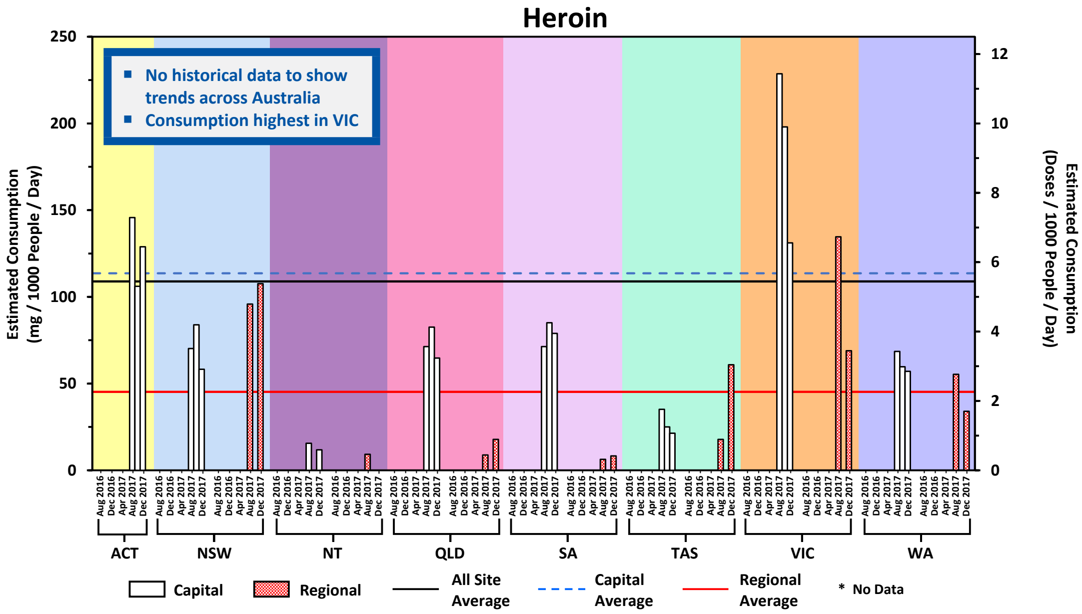
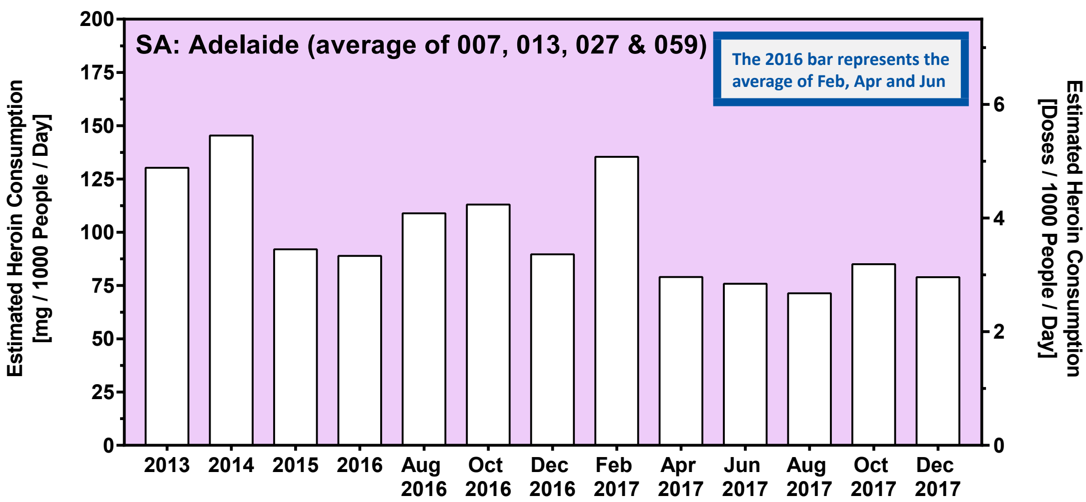


Figure 25: Change in heroin consumption in South Australia.



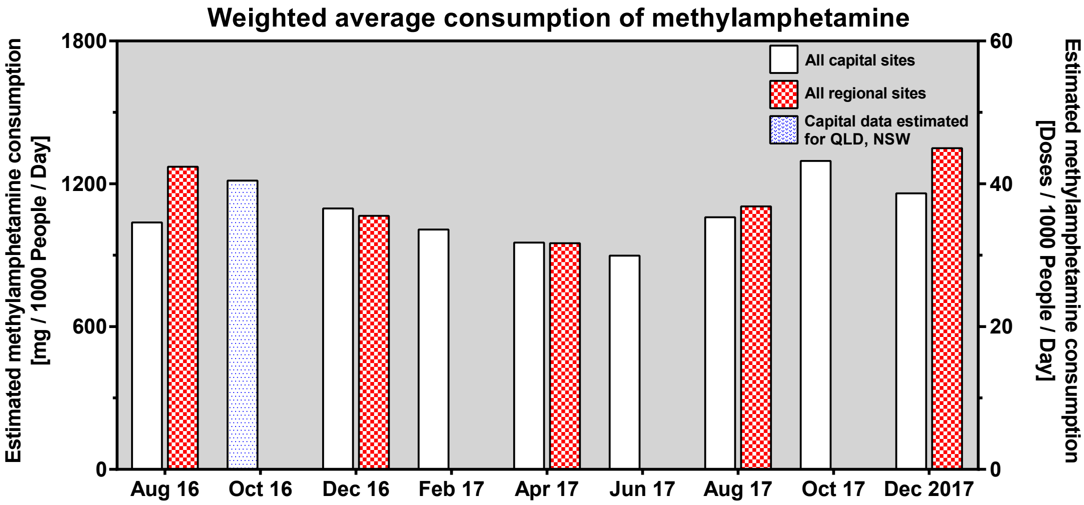
4.2.4 NEW PSYCHOACTIVE SUBSTANCES (NPS)

Methylone and mephedrone were only detected sporadically and at very low levels compared to other substances included in the report (December mephedrone and methylone results are shown in Table 3).

4.2.5 CAPITAL CITY AVERAGES

For the purposes of determining representative population trends for the collective catchments included in the report over the total sampling period, the averaged capital city site populations were expressed as the total capital average consumption of illicit stimulants (Figure 26). A complication with this type of analysis was that fewer sites were sampled between August 2016 and December 2017, so the contributing population was smaller between these dates. Some approximations had to be made to account for the absence of some densely populated regions (e.g. October 2016 for capital city New South Wales and Queensland). For the total population included in the report, methylamphetamine appeared to show a steady decline from October 2016 to June 2017, with an increase from August 2017. With additional data from future collections, the significance of any trend will become more apparent. MDMA levels declined overall over the year on year reporting period, but since detected levels are very low, the result may not be significant. Cocaine consumption has shown an overall increase since August 2016. In terms of legal substances with abuse potential, nicotine consumption remained largely unchanged over the reporting period (Figure 27). In contrast, the two pharmaceutical opioids included in the study showed an overall decline in capital city areas since August 2016. In regional areas, fentanyl remained steady for the year on year period, but showed a decline from August 2016 to April 2017. In the case of alcohol, marginal changes were evident.

Figure 26: The population-weighted average of all sites for methylamphetamine, MDMA and cocaine.



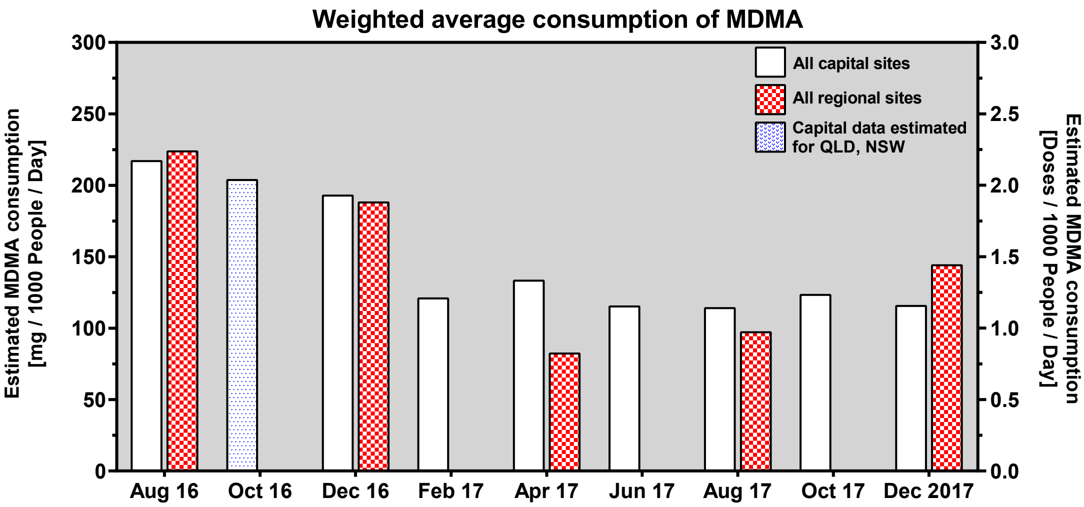
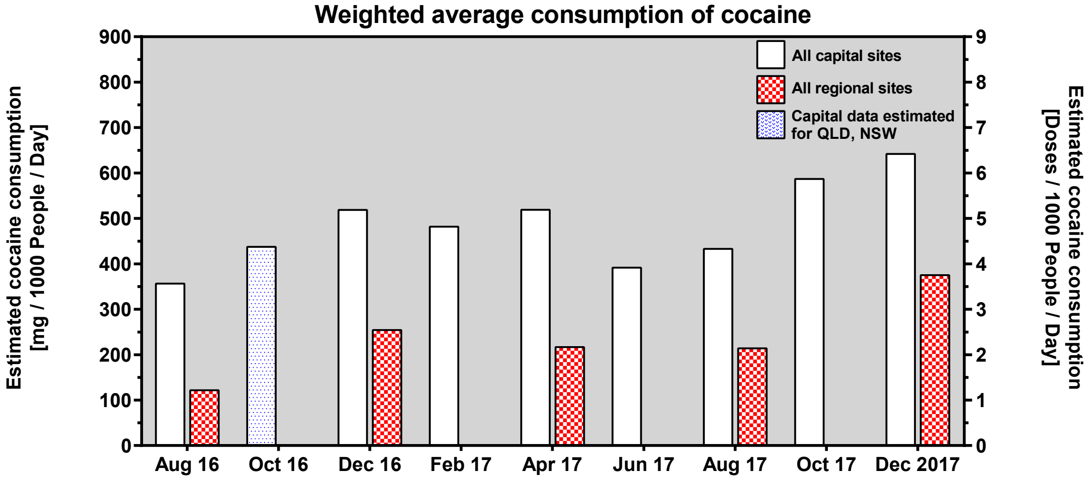
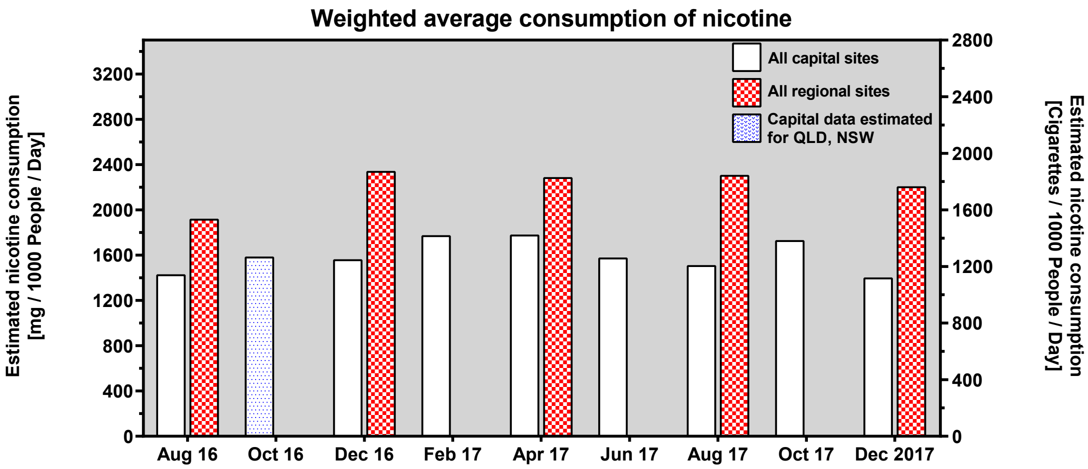


Figure 26 (continued): The population-weighted average of all sites for methylamphetamine, MDMA and cocaine.



As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate. Regional areas were only sampled every second collection period.

Figure 27: The population-weighted average of all sites for nicotine, alcohol, oxycodone, fentanyl and heroin.



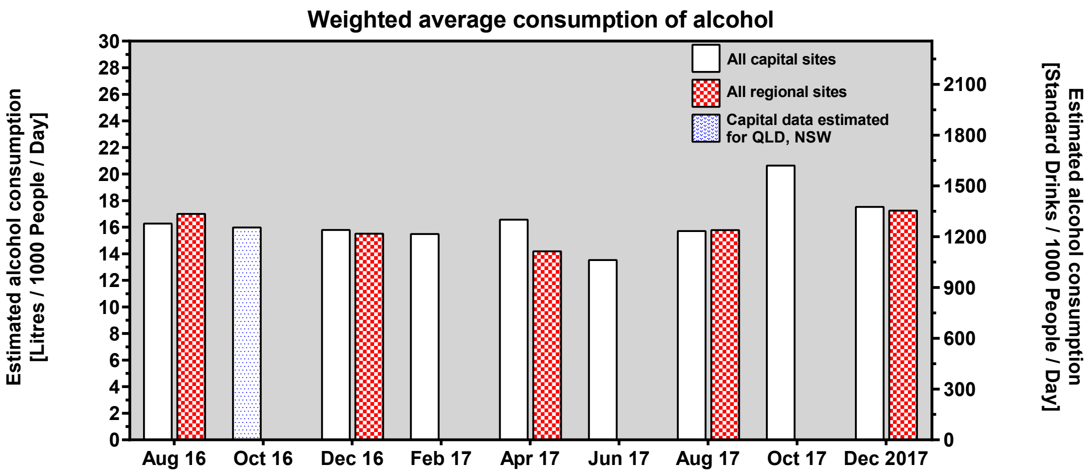
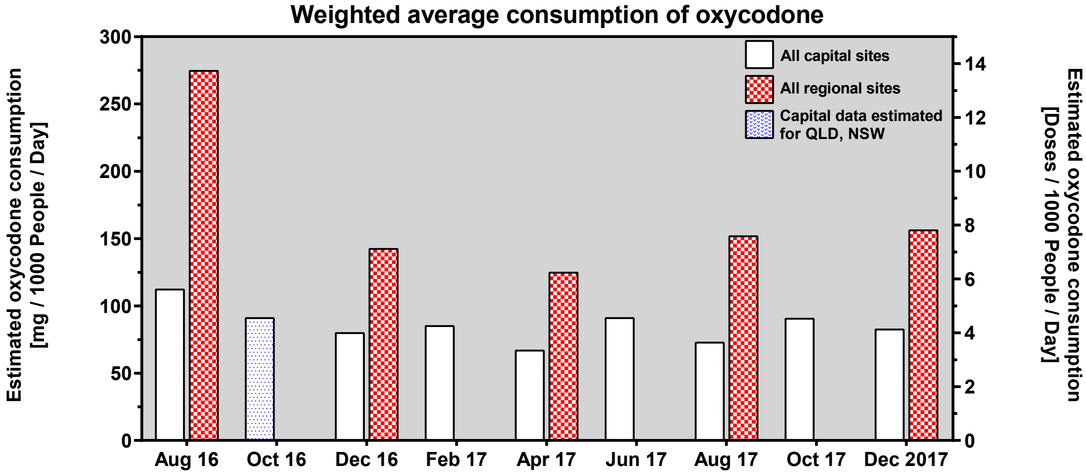
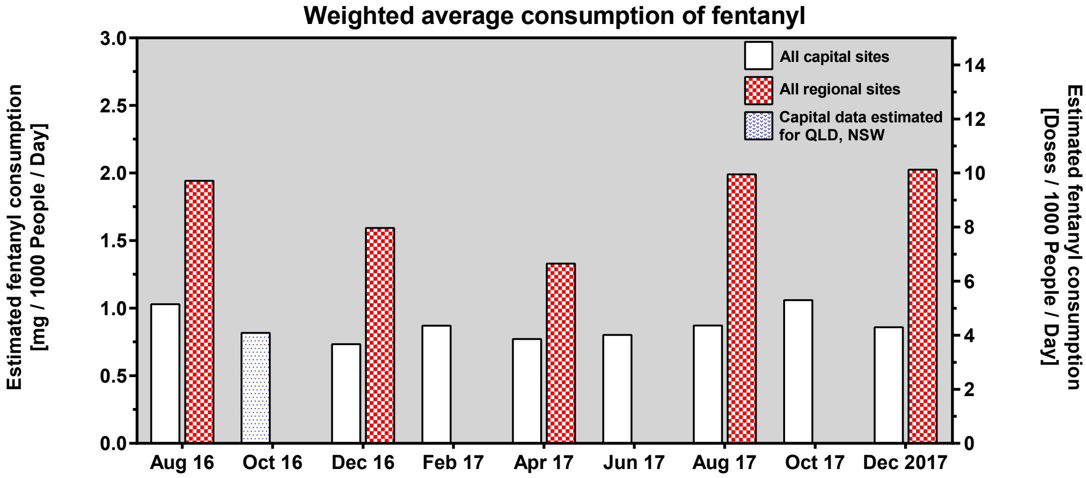
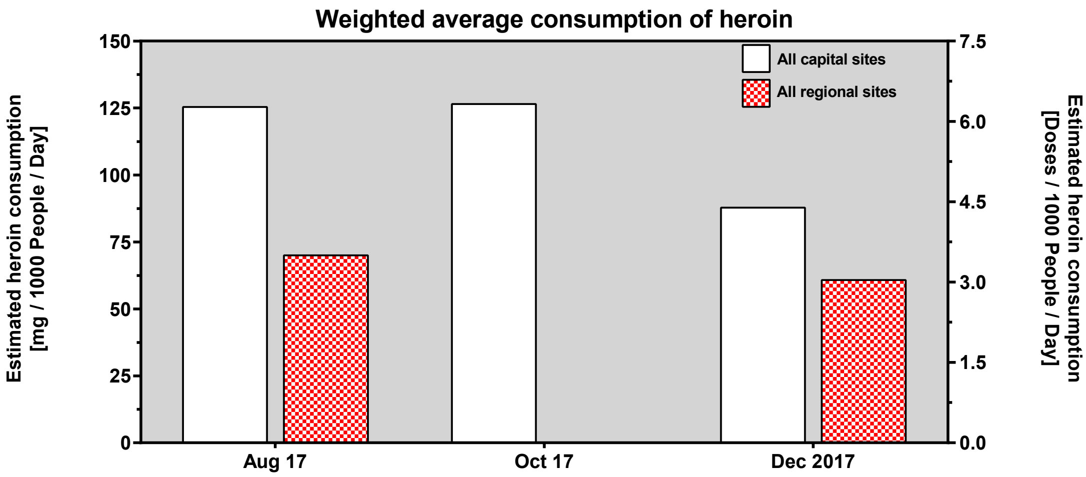


Figure 27 (continued): The population-weighted average of all sites for nicotine, alcohol, oxycodone, fentanyl and heroin.







As Queensland and New South Wales capital city sites were not sampled in October 2016, their average consumption in August and December 2016 was used to provide the overall October estimate. Regional areas were only sampled every second collection period.

4.3. DRUG PROFILE FOR EACH STATE AND TERRITORY

In order to compare the scale of use of different types of drugs within the same region (for example, within a state or territory), drug consumption was reported as the number of doses consumed. When the amount of drug measured in wastewater was normalised for population size and average dose consumed (conversion factors listed in the first National Wastewater Drug Monitoring Program report and in Appendix 1), alcohol and nicotine remained consistently the highest consumed drugs in all states and territories.
For example, the national average consumption of nicotine and alcohol per 1,000 people per day were 1,480 cigarettes per 1,000 people (Figure 5) and 1,370 standard drinks per day per 1,000 (Figure 6), whereas for methylamphetamine, the national average consumption was closer to 40 doses per 1,000 people per day (Figure 7).

In agreement with previous reports, methylamphetamine consumption remained the highest amongst the measured illicit drugs and opioids in this report, across all regions of Australia (Figure 28 and Figure 29). This trend was consistent for both capital cities and regional sites. Based on the consumption profiles of other drugs detected in this study (cocaine, MDMA, oxycodone and fentanyl), no other consistent patterns of usage within the different states and territories were observed. Oxycodone and fentanyl use were very similar within almost all states and territories, with small differences between the proportions in capital cities vs. regional areas.

Figure 28: Profile of average drug consumption by state or territory, for ACT, NSW, NT and QLD. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory).

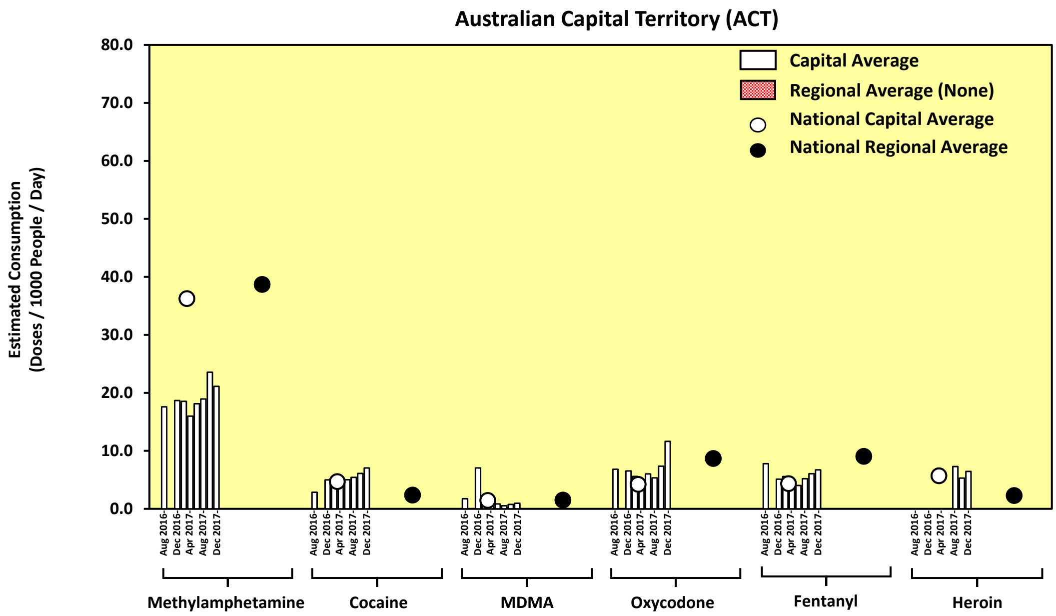


Figure 28 (continued): Profile of average drug consumption by state or territory, for ACT, NSW, NT and QLD.

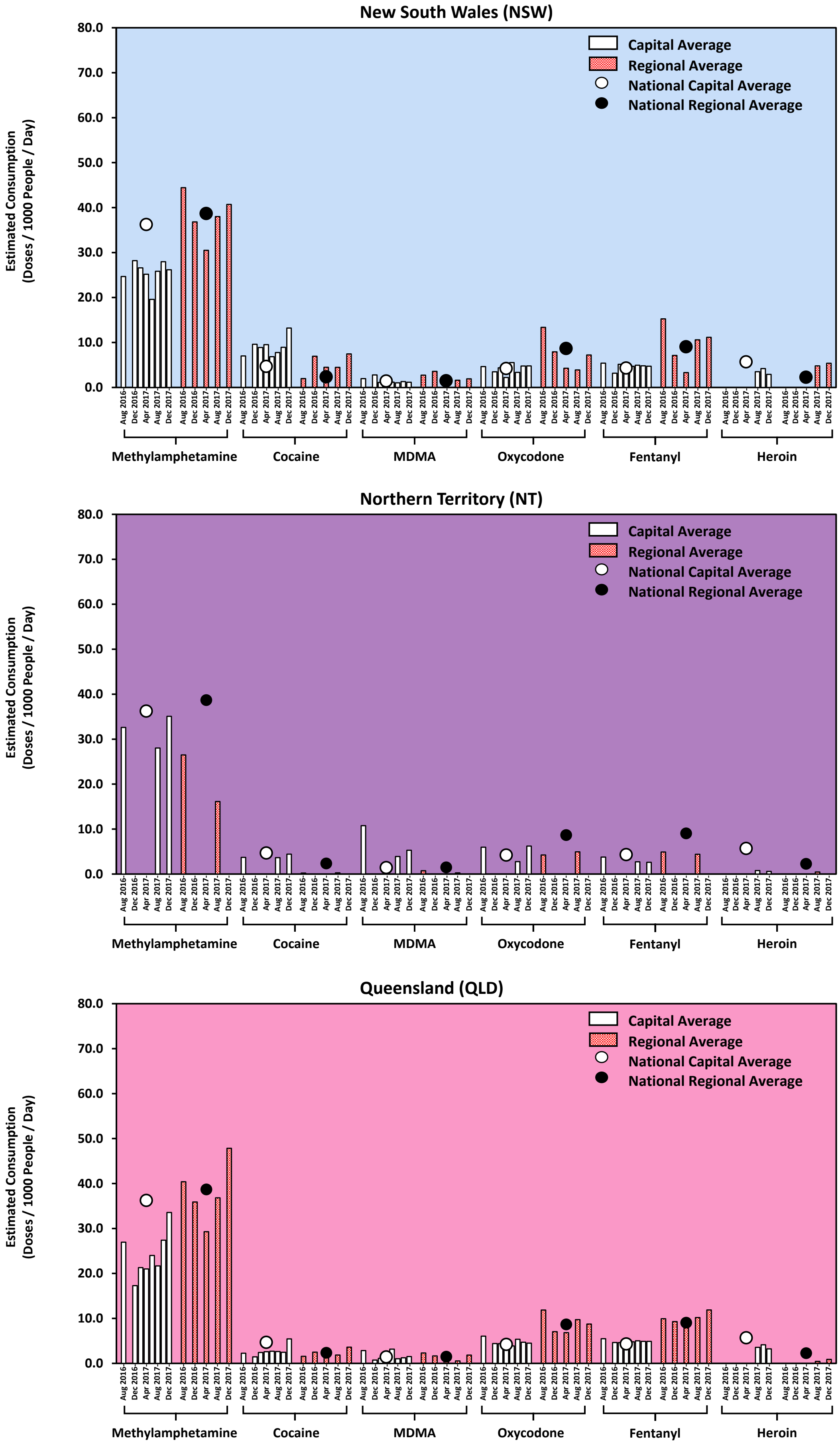
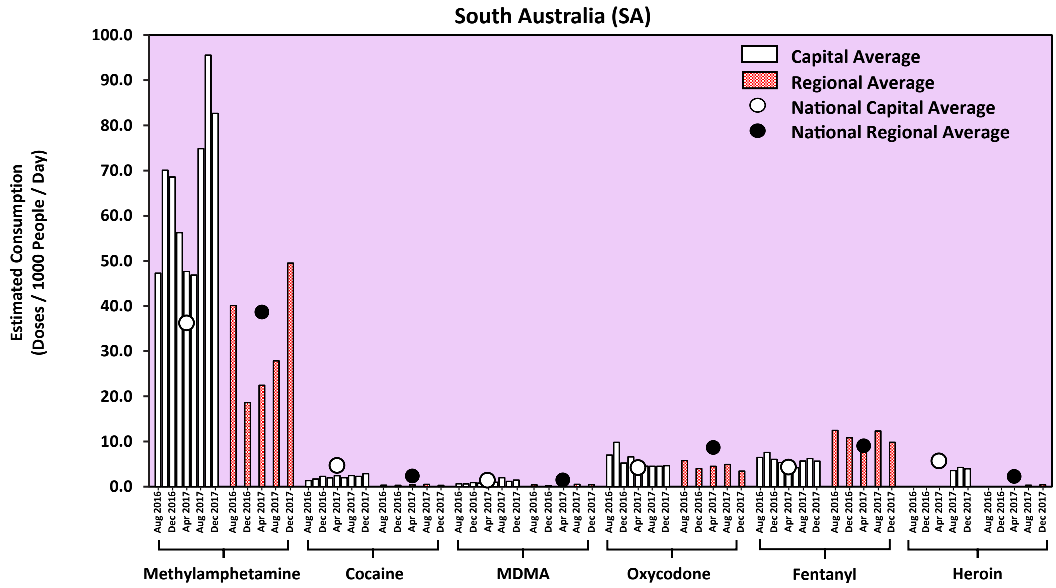


Figure 29: Profile of average drug consumption by state or territory, for SA, TAS, VIC and WA. Consumption is shown as the number of doses per 1,000 people per day to allow comparison of drugs of different types within the same region (state or territory).



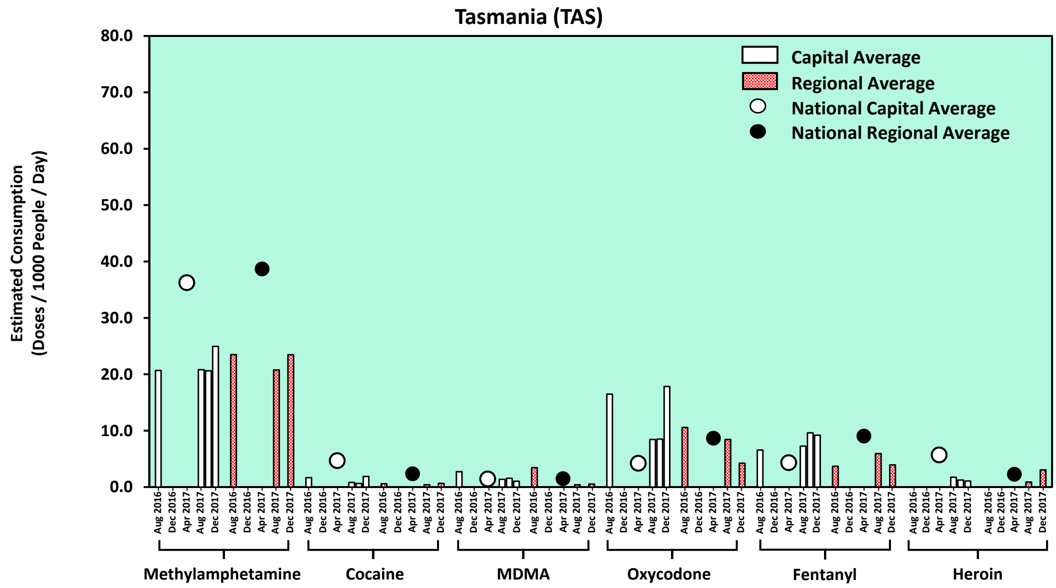
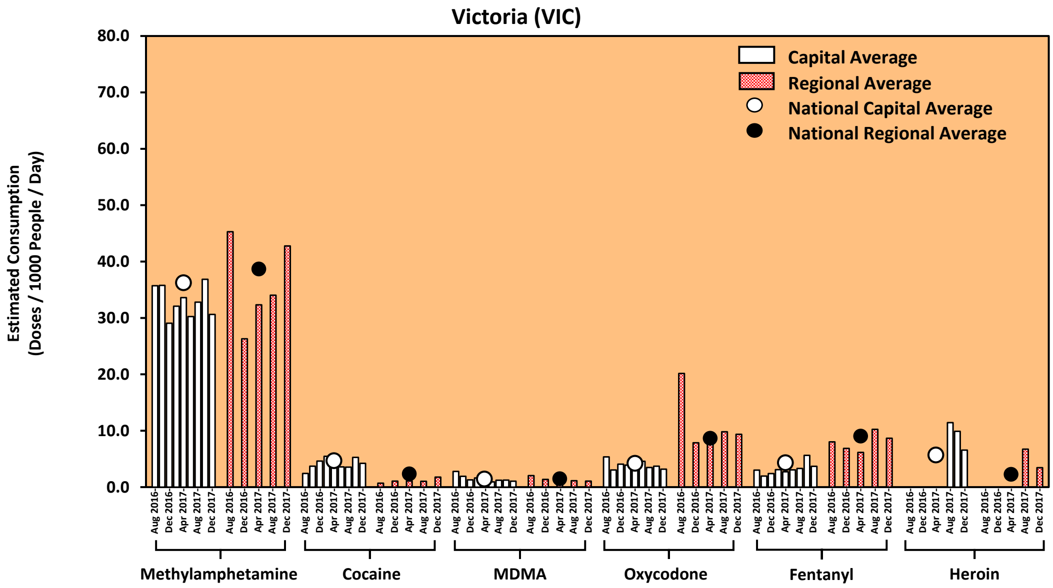
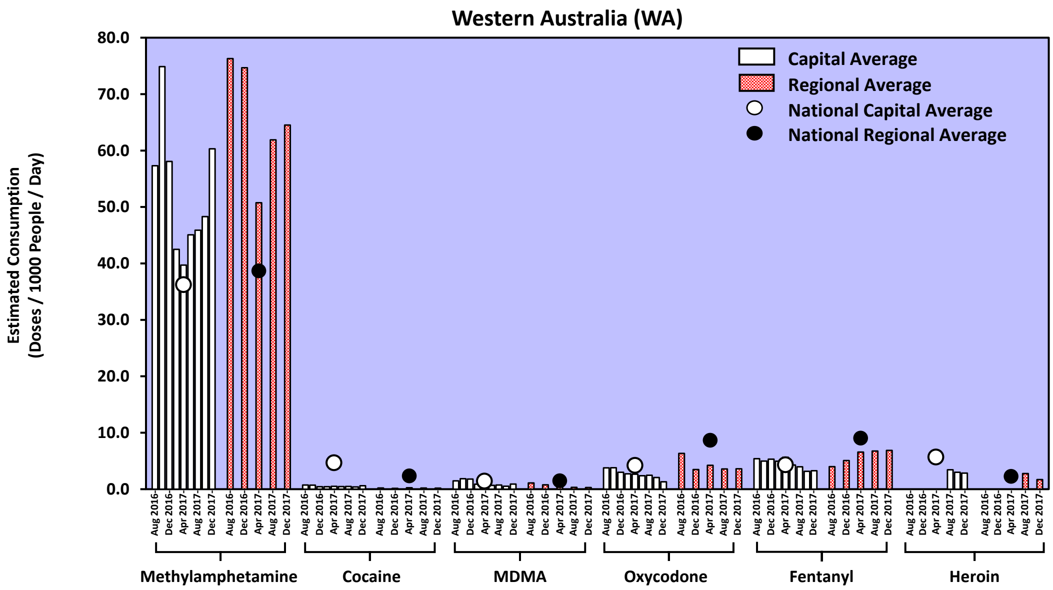


Figure 29 (continued): Profile of average drug consumption by state or territory, for SA, TAS, VIC and WA.





5: ACKNOWLEDGMENTS

The project team sincerely thank the numerous WWTP operators involved in sample collection and WWTP management agencies for providing flow volumes and other site information. The cooperation of the plants and management agencies is critical to the ongoing success of this project.

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The symbols/images used in Figure 1 in the report were provided courtesy of the Integration and Application Network, University of Maryland, Center for Environmental Science (ian.umces.edu/symbols/).

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7: APPENDICES

APPENDIX 1: DRUG-SPECIFIC PARAMETERS FOR ANALYTICAL REPORTING AND USAGE CALCULATIONS

Analyte levels of detection, levels of reporting, highest detection, excretion factors and standard doses from the literature.

Analyte	Level of detection (LOD) [ng/L]	Level of reporting (LOR) [ng/L]	Excretion Factor	Standard dose pure drug (mg)
Amphetamine	12	16	0.394[a]	30[b]
Cocaine	17	50	0.075[b]	100[b]
Cotinine	33	100	0.3[c]	1.25[c]
Norfentanyl	0.1	0.1	0.3[d]	0.2[d]
JWH-018	1	14	n.a.	n.a.
JWH-073	10	20	n.a.	n.a.
MDA *	1	4	n.a.	n.a.[#]
MDMA	1.5	2	0.225[b]	100[b]
Mephedrone	0.4	0.8	n.a.	n.a
Methylamphetamine	33	100	0.39[g]	30[b]
Methylone	0.01	0.1	n.a.	n.a.
Hydroxycotinine	17	50	0.44[c]	1.25[c]
Noroxycodone	0.1	1	0.22[f]	20[d]
Ethyl sulphate	167	500	0.00012[e]	10g[e]
Benzoylecgonine	33	100	0.35[g]	100[b]
6-monoacetylmorphine	0.5	1.0	0.013[h]	20[i]

n.a. = data not available; a = (Khan and Nicell 2012) ; b = (Zuccato et al. 2008); c = (Castiglioni et al. 2015); d = (Rossi 2016), e = (Ryu et al. 2016); f = (Lalovic et al. 2006); g = (Lai et al., 2011); h = (Boerner et al., 1975); i =(Sullivan et al. 2006)

* Data is not available in the scientific literature for the proportion of MDA that is eliminated after MDA consumption. However, data is available detailing the proportion of MDA eliminated after MDMA consumption. Therefore, our MDA estimate of mg excreted per day per 1 000 people is the amount of MDA excreted from the population after considering the metabolic fraction excreted from MDMA.

[#] It is likely that the dose for MDA is similar to that of MDMA, of 100 mg.

APPENDIX 2: NUMBER OF SITES ASSESSED IN EACH REPORT

Number of sites assessed in each state for Report 4, and total populations assessed. C = capital city wastewater treatment plant, R = regional wastewater treatment plant.

	Report 1		Report 2						Report 3						Report 4			
	Aug-16		*Oct-16		Dec-16		*Feb-17		Apr-17		*Jun-17		Aug-17		*Oct-17		Dec-17	
State/Territory	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R
ACT	1	–	–	–	1	–	1	–	1	–	1	–	1	–	1	–	1	–
NSW	5	5	–	–	3	3	3	–	3	2	3	–	5	7	3	–	3	5
NT	1	1	–	–	–	–	–	–	–	–	–	–	1	1	–	–	1	–
QLD	3	9	–	–	2	8	3	–	3	8	3	–	3	7	3	–	3	6
SA	4	4	4	–	4	5	4	–	4	5	4	–	4	5	4	–	4	5
TAS	3	4	–	–	–	–	–	–	–	–	–	–	3	3	3	–	3	2
VIC	2	5	2	–	2	3	2	–	2	2	2	–	2	6	2	–	2	4
WA	3	1	3	–	3	3	3	–	3	3	3	–	3	3	3	–	3	3
Population (millions) C & R	**11.5**	**1.6**	**6.5**	**–**	**10.6**	**1.3**	**11.1**	**–**	**11.1**	**1.2**	**11.1**	**–**	**11.5**	**1.7**	**11.2**	**–**	**11.2**	**1.5**
Total Population (millions)	**13.1**		**6.5**		**11.9**		**11.1**		**12.3**		**11.1**		**13.2**		**11.2**		**12.7**	
% of Australian population	**55.9%**		**27.8%**		**50.9%**		**47.4%**		**52.4%**		**47.4%**		**56.3%**		**47.9%**		**54.3%**	

* Every second time point aims to sample from only capital city sites. Census 2016 population used (23,401,892) for population percentage estimates.
Estimates have been rounded to the nearest 0.1 million. Note: catchment populations have been refined, and so population totals and percentages may have changed accordingly.

APPENDIX 3: FURTHER INFORMATION ON WWTPS

Sampling details of each wastewater treatment plant.

Site Code	Capital/Regional	# Samples Aug 16	# Samples Oct 16	# Samples Dec 16	# Samples Feb 17	# Samples Apr 17	# Samples Jun 17	# Samples Aug 17	# Samples Oct 17	# Samples Dec 17	Population Category
ACT: 009	Capital	7	-	7	7	7	7	7	7	7	>150,000
NSW: 003	Capital	7	-	7	4	7	7	7	7	7	>150,000
NSW: 006	Capital	7	-	7	7	7	7	7	7	7	>150,000
NSW: 008	Capital	6	-	7	7	7	7	7	7	7	>150,000
NSW: 021	Capital	7	-	-	-	-	-	7	-	0	30,000 to 150,000
NSW: 071	Capital	7	-	-	-	-	-	7	-	0	>150,000
NSW: 016	Regional	5	-	7	-	-	-	5	-	7	30,000 to 150,000
NSW: 025	Regional	7	-	-	-	-	-	7	-	7	>150,000
NSW: 040	Regional	7	-	-	-	-	-	7	-	0	<30,000
NSW: 051	Regional	7	-	-	-	-	-	7	-	0	<30,000
NSW: 068	Regional	1	-	4	-	7	-	7	-	7	>150,000
NSW: 081	Regional	-	-	-	-	-	-	7	-	7	<30,000
NSW: 115	Regional	-	-	7	-	7	-	7	-	7	30,000 to 150,000
NT: 010	Capital	7	-	-	-	-	-	7	-	7	30,000 to 150,000
NT: 078	Regional	7	-	-	-	-	-	7	-	0	<30,000
QLD: 002	Capital	7	-	6	6	7	7	7	7	7	>150,000
QLD: 005	Capital	7	-	-	7	7	7	6	6	7	>150,000
QLD: 011	Capital	7	-	7	6	7	7	6	7	7	>150,000
QLD: 012	Regional	5	-	7	-	7	-	7	-	6	>150,000
QLD: 020	Regional	7	-	-	-	-	-	-	-	0	<30,000
QLD: 024	Regional	7	-	7	-	7	-	-	-	0	30,000 to 150,000
QLD: 028	Regional	7	-	7	-	7	-	7	-	0	30,000 to 150,000
QLD: 029	Regional	7	-	7	-	7	-	7	-	7	30,000 to 150,000
QLD: 033	Regional	7	-	7	-	7	-	7	-	7	30,000 to 150,000
QLD: 039	Regional	7	-	7	-	7	-	7	-	7	<30,000
QLD: 053	Regional	7	-	3	-	5	-	7	-	5	<30,000
QLD: 077	Regional	7	-	7	-	7	-	7	-	7	<30,000
SA: 007	Capital	5	7	7	7	7	7	7	7	7	>150,000
SA: 013	Capital	5	7	7	7	7	7	7	7	7	>150,000
SA: 027	Capital	5	7	7	7	7	7	7	7	7	30,000 to 150,000

Sampling details of each wastewater treatment plant (continued).

Site Code	Capital/Regional	# Samples Aug 16	# Samples Oct 16	# Samples Dec 16	# Samples Feb 17	# Samples Apr 17	# Samples Jun 17	# Samples Aug 17	# Samples Oct 17	# Samples Dec 17	Population Category
SA: 059	Capital	5	7	7	7	7	7	7	7	6	30,000 to 150,000
SA: 017	Regional	5	-	4	-	4	-	4	-	4	<30,000
SA: 022	Regional	5	-	4	-	4	-	4	-	4	<30,000
SA: 063	Regional	5	-	4	-	5	-	4	-	4	<30,000
SA: 076	Regional	5	-	4	-	4	-	4	-	4	<30,000
SA: 119	Regional	-	-	4	-	4	-	4	-	4	<30,000
TAS: 004	Capital	7	-	-	-	-	-	5	5	5	30,000 to 150,000
TAS: 019	Capital	7	-	-	-	-	-	5	5	5	30,000 to 150,000
TAS: 041	Capital	7	-	-	-	-	-	4	5	5	30,000 to 150,000
TAS: 018	Regional	7	-	-	-	-	-	5	-	7	30,000 to 150,000
TAS: 038	Regional	7	-	-	-	-	-	-	-	0	<30,000
TAS: 048	Regional	7	-	-	-	-	-	5	-	5	<30,000
TAS: 058	Regional	7	-	-	-	-	-	5	-	0	<30,000
VIC: 001	Capital	7	7	7	7	7	7	7	7	7	>150,000
VIC: 067	Capital	7	7	7	7	7	7	7	7	7	>150,000
VIC: 037	Regional	7	-	7	-	-	-	7	-	7	>150,000
VIC: 046	Regional	7	-	-	-	-	-	7	-	0	30,000 to 150,000
VIC: 061	Regional	7	-	7	-	7	-	7	-	7	30,000 to 150,000
VIC: 062	Regional	7	-	-	-	-	-	5	-	0	30,000 to 150,000
VIC: 066	Regional	6	-	7	-	7	-	7	-	7	30,000 to 150,000
VIC: 114	Regional	-	-	-	-	-	-	5	-	7	30,000 to 150,000
WA: 101	Capital	7	7	7	7	7	7	7	7	7	>150,000
WA: 103	Capital	7	7	7	7	7	7	7	7	7	>150,000
WA: 104	Capital	7	7	7	7	7	7	7	7	7	>150,000
WA: 102	Regional	7	-	7	-	7	-	7	-	7	30,000 to 150,000
WA: 118	Regional	0	-	7	-	7	-	7	-	0	<30,000
WA: 120	Regional	-	-	7	-	7	-	7	-	7	30,000 to 150,000
WA: 129	Regional	-	-	-	-	-	-	-	-	7	<30,000
	Total Days	329	63	236	107	236	112	342	126	288	
	Total Sites	51	9	37	16	36	16	54	19	45	
	Total Capital	22	9	15	16	16	16	22	19	20	
	Total Regional	29	0	22	0	20	0	32	0	25	
	Total samples in Report 1; August 2016:	**329**		Total samples in Report 2; Oct & Dec 2016 & Feb 2017:	**406**		Total samples in Report 3; Apr & Jun & Aug 2017:	**690**		Total samples in Report 4; Oct & Dec 2017: **414**	Grand total number of samples analysed for Report 1, 2, 3 & 4: **1,839**

APPENDIX 4: POPULATION ESTIMATION: PERCENTAGE OVERCOUNT OR UNDERCOUNT BY SITE

Percentage undercount, overcount and total overcount or undercount for all site population estimates.

Site number	State	Capital or regional	Potential undercount (%)	Potential overcount (%)	Total undercount + overcount (%)
001	VIC	Capital	2.11	1.97	4.08
002	QLD	Capital	1.03	1.23	2.26
003	NSW	Capital	0.61	0.57	1.18
004	TAS	Capital	3.15	1.79	4.94
005	QLD	Capital	1.17	1.12	2.29
006	NSW	Capital	1.00	1.21	2.21
007	SA	Capital	0.92	0.81	1.73
008	NSW	Capital	1.71	1.90	3.61
009	ACT	Capital	0.01	0.09	0.10
010	NT	Capital	0.99	0.23	1.22
011	QLD	Capital	2.28	2.72	5.00
012	QLD	Regional	0.38	0.09	0.47
013	SA	Capital	0.86	1.38	2.24
016	NSW	Regional	1.91	1.75	3.66
017	SA	Regional	2.65	0.69	3.34
018	TAS	Regional	2.64	4.42	7.06
019	TAS	Capital	0.74	0.44	1.18
020	QLD	Regional	5.88	5.07	10.95
021	NSW	Capital	2.32	2.55	4.87
022	SA	Regional	2.67	2.17	4.84
024	QLD	Regional	0.89	0.69	1.58
025	NSW	Regional	1.52	1.29	2.81
027	SA	Capital	4.45	5.05	9.50
028	QLD	Regional	0.82	1.10	1.92
029	QLD	Regional	0.59	0.99	1.58
033	QLD	Regional	1.96	1.76	3.72
037	VIC	Regional	0.80	0.92	1.72
038	TAS	Regional	1.86	2.46	4.32
039	QLD	Regional	0.07	0.29	0.36
040	NSW	Regional	1.07	1.00	2.07
041	TAS	Capital	1.31	2.41	3.72
046	VIC	Regional	3.21	2.58	5.79

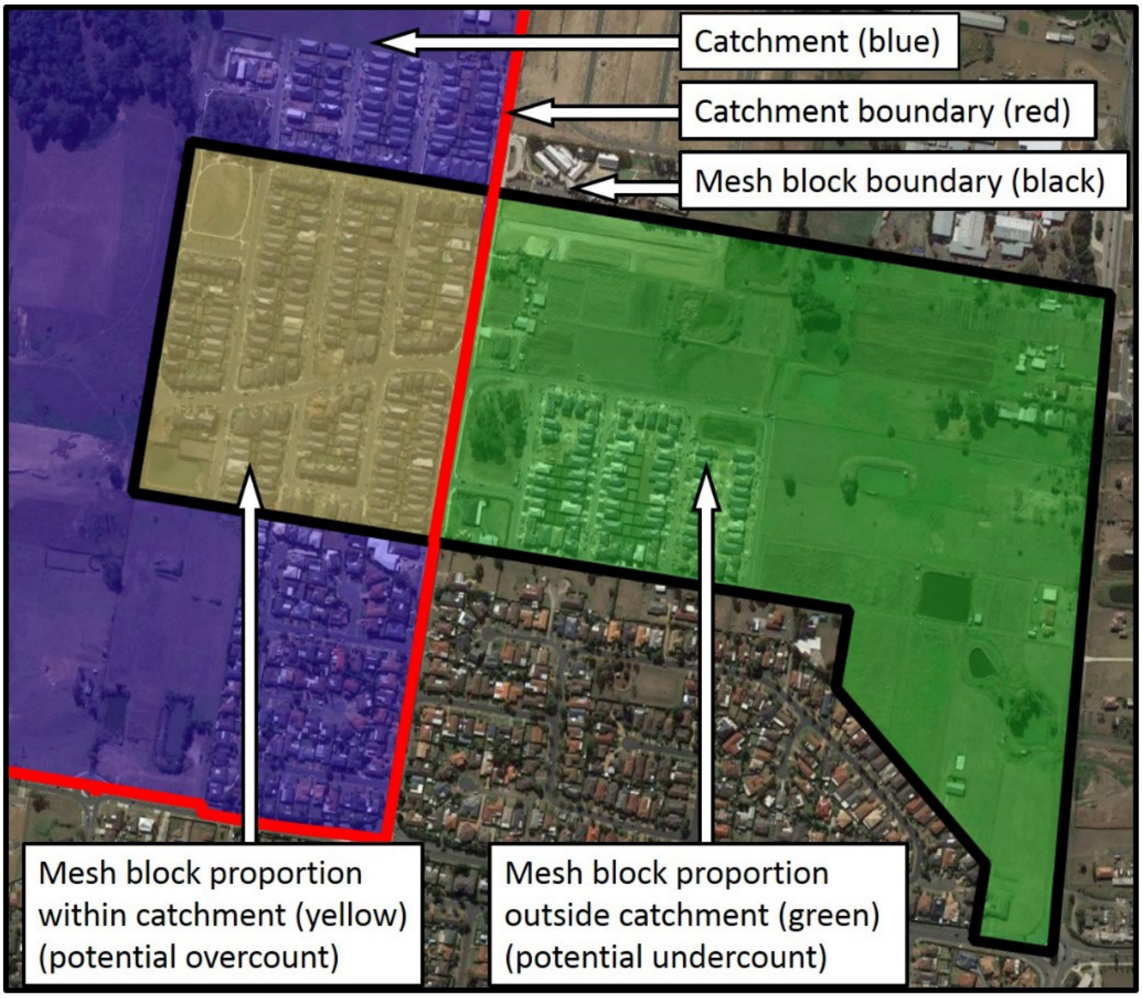
Percentage undercount, overcount and total overcount or undercount for all site population estimates (continued).

Site number	State	Capital or regional	Potential undercount (%)	Potential overcount (%)	Total undercount + overcount (%)
048	TAS	Regional	1.77	0.63	2.40
051	NSW	Regional	0.41	0.14	0.55
053	QLD	Regional	2.30	1.77	4.07
058	TAS	Regional	2.74	1.63	4.37
059	SA	Capital	0.69	0.67	1.36
061	VIC	Regional	2.06	2.79	4.85
062	VIC	Regional	7.25	6.94	14.19
063	SA	Regional	0.87	0.44	1.31
066	VIC	Regional	0.54	0.59	1.13
067	VIC	Capital	0.99	0.96	1.95
068	NSW	Regional	0.10	0.09	0.19
071	NSW	Capital	0.22	0.22	0.44
076	SA	Regional	2.86	3.07	5.93
077	QLD	Regional	8.50	5.28	13.78
078	NT	Regional	1.08	2.41	3.49
081	NSW	Regional	0.37	1.59	1.96
085	NT	Capital	0.23	0.86	1.09
101	WA	Capital	0.71	0.74	1.45
102	WA	Regional	1.35	0.19	1.54
103	WA	Capital	1.13	1.03	2.16
104	WA	Capital	0.27	0.23	0.50
114	VIC	Regional	3.12	2.31	5.43
115	NSW	Regional	2.52	3.13	5.65
118	WA	Regional	No catchment map available	No catchment map available	No catchment map available
119	SA	Regional	0.44	1.59	2.03
120	WA	Regional	No catchment map available	No catchment map available	No catchment map available
129	WA	Regional	17.49	0.82	18.31
		Average (%):	**1.99**	**1.63**	**3.62**

APPENDIX 5: POPULATION ESTIMATION METHODOLOGY: PERCENTAGE OVERCOUNT OR UNDERCOUNT BY SITE

The refined catchment population estimate uses the area of a mesh block within the catchment to estimate the proportion of the population within the catchment (where a mesh block is the smallest population unit of the 2016 Australian Census). However, when the population within the mesh blocks are not distributed equally this can decrease the precision of the estimate. The potential overcount and undercount estimates are a measure of precision of the refined population estimate. Some uncertainty is caused by the potential unequal population distribution for the mesh blocks that intersect the catchment boundary. A diagram outlining these terms is shown in the below figure, as well as the formulas used to calculate the overcount and undercount estimates. As can be seen in the figure, the population distribution across this particular mesh block is unequal when comparing the green and yellow areas. On average, the wastewater catchments used in this study had a 4 per cent combined population overcount or undercount estimate. This demonstrates that, in the vast majority of cases, the associated precision can be assumed to be very high for the Census-generated population estimates for the usual residence population. It should be noted that day-to-day population differences within a catchment due to seasonal tourism or commuting cannot be elucidated by this population estimate. However, for the capital city areas commuting is less likely to affect population estimates as multiple catchments per city are assessed concurrently (and include the CBD), so movement from one catchment to another would be captured.

Percentage overcount and undercount estimates surrounding the mesh block (Census) population estimate and the formulas used to calculate the overcount and undercount estimates. Note: the boundaries displayed are for instructional purposes only and do not relate to a real catchment.



$$\text{Percent Undercount} = \frac{\textbf{Mesh block populations within boundary} + \textbf{mesh block populations outside boundary}}{\textbf{Mesh block populations within boundary}} \times 100$$

$$\text{Percent Undercount} = \frac{\textbf{Mesh block populations within boundary}}{\textbf{Mesh block populations with area fully within boundary (excluding yellow)}} \times 100$$

APPENDIX 6: PERCENTAGE OF SAMPLES ABOVE LOD (%) FOR EACH DRUG AND PERIOD ASSESSED

The proportion of samples that each drug was detected above LOD for Report 1-4. Note: regional sites are only sampled every second period.

		Drug detections % (above LOD) Report 1-4								
		Aug 2016	Oct 2016	Dec 2016	Feb 2017	Apr 2017	Jun 2017	Aug 2017	Oct 2017	Dec 2017
Methylamphetamine	Capital	100	100	100	100	100	100	100	100	100
Methylamphetamine	Regional	100		100		100		100		100
Cocaine	Capital	97	97	96	96	97	96	90	90	95
Cocaine	Regional	45		52		53		53		56
MDMA	Capital	100	100	100	100	100	96	100	100	100
MDMA	Regional	95		96		100		98		100
MDA	Capital							98	92	100
MDA	Regional							86		95
Oxycodone	Capital	100	100	100	100	100	100	100	100	100
Oxycodone	Regional	100		100		100		100		100
Fentanyl	Capital	100	97	100	99	100	100	100	100	100
Fentanyl	Regional	96		94		99		100		100
Heroin	Capital							83	92	84
Heroin	Regional							37	-	59
Alcohol	Capital	100	100	100	100	100	100	100	100	100
Alcohol	Regional	100		100		100		100		100
Nicotine	Capital	100	100	100	100	100	97	100	100	100
Nicotine	Regional	100		100		100		100		100
Mephedrone	Capital	2	-	-	-	-	1	-	1	24
Mephedrone	Regional	-		3		3		1		12
Methylone	Capital	45	19	47	28	79	7	28	46	59
Methylone	Regional	41		14		9		22		22

CONCLUSIONS

CONCLUSIONS

For the fourth report of the National Wastewater Drug Monitoring Program, wastewater analysis was conducted in October and December 2017. The program has identified variations in patterns of drug consumption, both over time and within and between jurisdictions. Consistent with previous reports, findings show that, of the substances monitored, nicotine and alcohol are the most consumed drugs in Australia. Methylamphetamine remains the most consumed illicit drug of those tested in Australia, with estimated consumption significantly exceeding that of other monitored illicit drugs.

METHYLAMPHETAMINE

The population-weighted average consumption of methylamphetamine for both capital city and regional sites increased from August 2017 to December 2017. The regional average consumption of methylamphetamine exceeded capital city average consumption. South Australia had the highest estimated average capital city consumption of methylamphetamine in December 2017, with Western Australia having the highest estimated average regional consumption.

AMPHETAMINE

Amphetamine is a metabolite of methylamphetamine consumption. While the program measured amphetamine consumption, measured consumption was not reported separately as levels measured were consistent with observed levels related to methylamphetamine consumption.

COCAINE

The population-weighted average consumption of cocaine for both capital city and regional sites increased from August 2017 to December 2017. The capital city average consumption of cocaine was almost double the regional average. New South Wales had the highest estimated average capital city and regional consumption of cocaine in December 2017.

3,4-METHYLENEDIOXYMETHYLAMPHETAMINE (MDMA)

The population-weighted average consumption of MDMA in capital city sites remained relatively stable in December 2017, while there was an increase in regional sites compared to August 2017. Regional average consumption was very similar to capital city average consumption. The Northern Territory had the highest estimated average capital city consumption of MDMA in December 2017, with New South Wales and Queensland having the highest estimated average regional consumption.

3,4-METHYLENEDIOXYAMPHETAMINE (MDA)

MDA is a metabolite of MDMA. As the proportion of MDA derived from MDMA is known, it has been possible from Report 3 to estimate MDA consumption rather that its presence solely as a metabolite of MDMA use. Regional average consumption of MDA exceeded capital city average consumption. Site 12 in Queensland is of particular concern given the very high consumption levels reported in December 2017. Tasmania had the highest estimated average capital city consumption of MDA in December 2017, with New South Wales and Queensland having the highest estimated average regional consumption.

HEROIN

Population-weighted averages for heroin consumption for both capital city and regional sites decreased from August 2017 to December 2017. Capital city average consumption of heroin is more than double regional average consumption. The Australian Capital Territory and Victoria had the highest estimated average capital city consumption of heroin in December 2017, with New South Wales having the highest estimated average regional consumption.

MEPHEDRONE

Consistent with previous reporting periods, mephedrone was mostly detected below the level at which it could be reliably quantified. The number of detections of mephedrone more than doubled between August and December 2017. Mephedrone was detected 23 times at six sites in December 2017, compared to 11 times at seven sites in August 2017. In December 2017, mephedrone was detected in New South Wales and Queensland, with detections in August 2017 located in Queensland, Victoria and Western Australia.

METHYLONE

Consistent with previous reporting periods, methylone was mostly detected below the level at which it could be reliably quantified. The number of national detections of methylone decreased from 90 in August 2017 to 65 in December 2017. Methylone was detected at 17 sites in December 2017, a decrease from the 22 sites in August 2017. In December 2017, methylone was detected in all states and territories with the exception of Western Australia, with detections of methylone in August 2017 located in all states and territories with the exception of the Australian Capital Territory and South Australia.

OXYCODONE

The population-weighted average consumption of oxycodone in regional sites remained relatively stable in December 2017 compared to August 2017, with an increase in capital city consumption. Regional average consumption of oxycodone was almost double the capital city average. Tasmania had the highest estimated average capital city consumption of oxycodone in December 2017, with Victoria having the highest estimated average regional consumption.

FENTANYL

The population-weighted average consumption of fentanyl remained relatively stable in both capital city and regional sites in December 2017 compared to August 2017. Regional average consumption of fentanyl was almost double the capital city average. Tasmania had the highest estimated average capital city consumption of fentanyl in December 2017, with Queensland having the highest estimated average regional consumption.

NICOTINE[1]

Nicotine remains one of the most consumed drugs in Australia. The population-weighted average consumption of nicotine decreased between August 2017 and December 2017. The regional average consumption of nicotine exceeded capital city average consumption. The Northern Territory and Tasmania had the highest estimated average capital city consumption of nicotine in December 2017, with Tasmania having the highest estimated average regional consumption.

ALCOHOL

Alcohol remains one of the most consumed drugs in Australia. The population-weighted average alcohol consumption in both capital city and regional sites increased between August 2017 and December 2017. No significant differences in alcohol consumption were observed between capital city sites and regional sites. The Northern Territory had the highest estimated average capital city consumption of alcohol in December 2017, with Tasmania having the highest estimated average regional consumption.

NEXT REPORT

The fifth report of the National Wastewater Drug Monitoring Program is scheduled to be publicly released in the third quarter of 2018. The next report will incorporate the latest Sewage Analysis CORe group Europe (SCORE) data to provide insight into Australia's drug consumption in comparison with that of other countries participating in the SCORE program.

1 For accuracy, estimates have been changed from tobacco in Report 1 and 2 to nicotine in this report due to the inability to distinguish between nicotine intake from tobacco or electric cigarettes and nicotine replacement therapies such as patches and gum.